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The Acceptability of Writing by Second Language Engineering Students: Acculturating to a Profession

Waltraud Trudy O'Brien

A Thesis

in

The Humanities Doctoral Program

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ABSTRACT

The Acceptability of Writing by Second Language Engineering Students: Acculturating to a Profession

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Concordia University, 2000

Acculturation to a specialized field such as engineering is difficult for any novice, but especially so for writers who must achieve competency in the linguistic, cultural, academic, and professional norms of their second language. Technical reports written by both native English-speaking students (NES) and students who use English as a second language (ESL) for a university undergraduate engineering course are analyzed in terms of their respective performance levels as well as in relation to demographic information. This is done to ascertain whether differences between the NES and ESL students' results are due to variables beyond the obvious language-related factors. Analysis of the findings reveal that although NES and ESL students attained similar means on their writing task, ESL students had compensated for conceptual or linguistic weaknesses through mastery of structural (organization and format) aspects of the report. Demographic and other non-linguistic factors are also found to have a complex influence on the writing proficiency levels of the ESL students.

A subset of twenty reports is submitted for further blind assessment by professional engineers in order to discover whether the acceptability of the reports to professionals in the field is language-dependent or whether factors relating to levels of acculturation to the writing demands of the discipline of engineering are at play. The assessors' responses reveal common assumptions about professional technical writing requirements,

thus invoking membership in a rhetorical discourse community for engineering. However, they are also shown to be diverse in their applications of its rules, both in assessing the quality of each report and in deciding whether to hire the student writer as a junior engineer. The specific features of acceptability and acculturation to engineering writing lend themselves not simply to analysis and description, but also to explicit instruction in English for specific purposes, with concomitant benefits to the profession as a whole.

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With respect and love, I dedicate this dissertation to my late father, Herman Ostendorf, who told me since I was a young child that he would support my aspirations for a Ph.D. and who always encouraged a love of learning.

TABLE OF CONTENTS

LIST OF FIGURES x

LIST OF TABLES xi

LIST OF APPENDICES xi

CHAPTER 1: INTRODUCTION AND REVIEW OF LITERATURE 1
- 1.1 Context 3
- 1.2 Educational Issues in the Canadian Context Related to Engineering 4
  - 1.2.1 Educational Issues for Second Language Learners 7
  - 1.2.2 Industry Needs 8
  - 1.2.3 Lack of Relevant Writing Experience 10
- 1.3 Characteristics of Technical Writing: What do we need to know in order to best prepare ESL students? 13
  - 1.3.a Subject Matter Focus 13
  - 1.3.b Objectivity. 14
  - 1.3.c Vocabulary. 15
  - 1.3.d Linearity 15
  - 1.3.e Different Formats 15
  - 1.3.f Graphics. 16
  - 1.3.g Rhetorical Functions of Technical Writing. 16
  - 1.3.1 Engineering Writing as a Way of Thinking 18
  - 1.3.2 The Role of Writing in Engineering 20
- 1.4 Theories on the Development of Writing 24
  - 1.4.1 Behaviourist and Early Cognitive Approaches to the Study of Writing 25
  - 1.4.2 The Current-Traditional Approach to Writing. 27
  - 1.4.3 The New Rhetoric 29
  - 1.4.4 The Cognitive Process Model of How Writers Create Text. 31
  - 1.4.5 The Social Views of Writing. 40
  - 1.4.6 Genre Perspectives Within the Social View of Writing 53
- 1.5 Learning to Write English for Specific Purposes in a Second Language Context 57
  - 1.5.1 Problems of the ESL Writer: Language or Acculturation? 65
- 1.6 Selection of an Appropriate Research Perspective 67
- 1.7 Statement of Purpose 71
- 1.8 Research Questions 73

CHAPTER 2: METHODOLOGY 75
- 2.1 Participants 75
  - 2.1.1. Students 75
  - 2.1.2. Evaluators 76
    - 2.1.2.a Markers 76
    - 2.1.2.b Assessors 77
- 2.2 Instruments 77
  - 2.2.1 Writing Project Reports 77
  - 2.2.2 Questionnaires 79

2.2.3 Writing Project Evaluation Criteria 79
2.2.3.a Report Criteria as Presented on the Evaluation Sheets 79
2.2.3.b Assessors' Criteria for the Sample Subset as Presented on the Appraisal Forms 81
2.2.3.c Assessors' Comments 82
2.3 Procedures with Data Sources 82
2.3.1 Pilot Study 82
2.3.2 Student Questionnaires 83
2.3.3 Writing Project Research Reports and Performance Levels 84
2.3.4 Sample Subset of Twenty Reports 84
2.3.5 Assessors' Packages 85
2.4 Quantitative Analyses 86
2.4.1 Quantitative Analysis of Questionnaire Data 86
2.4.2 Quantitative Analysis of Evaluation Sheet Results 86
2.4.3 Performance Levels Related to Questionnaire Data 87
2.4.4 Evaluation of Sample Subset of 20 Reports by Engineer Assessors 88
2.5 Qualitative Analyses 89
2.5.1 Assessors' Comments on the Texts 89
2.5.2 Assessors' Reasons for Deciding Whether the Report Writers were NES or ESL Students 90
2.5.3 Genre Analysis of Assessors' Comments 90
2.6 Summary of Methodology 92

CHAPTER 3: RESULTS OF THE ANALYSIS OF THE EVALUATION SHEETS FOR THE WRITING PROJECT REPORTS 95
3.1 Scores for Participants (N = 202) on the Evaluation Sheets 95
3.2 Performance Level Scores by Category 98
3.3 Question Analysis by Category of all Evaluation Sheets 99
3.3.1 Content 99
3.3.2 Organization 101
3.3.3 Format 103
3.3.4 Language 104
3.4 Analysis of Performance Levels Related to Demographic Variables 106
3.4.1 Demographic Variables with No Statistical Relationship to Performance Levels and Low Descriptive Interest 107
3.4.2 Demographic Variables with Some Statistical Relationship to Performance Levels and Moderate Descriptive Interest 108
3.4.3 Demographic Variables with Stronger Statistical Relationship to Performance Levels and High Descriptive Interest 112
3.4.4 Kinds of Writing Selected by NES and ESL Students 114
3.5 Summary Conclusion to Analysis of Writing Project Evaluation Sheets 118
3.6 Analysis of the Twenty Sample Subset Reports 119

CHAPTER 4: RESULTS OF THE ASSESSORS' EVALUATIONS OF THE SAMPLE SUBSET REPORTS 121
4.1 Analysis of the Assessors' Quantitative Responses 121
4.2 Assessors' Scores on Subset Reports Compared to the Writing Project Results 122
4.2.1 Assessors' Scores on Appraisal Forms for NES Reports 123
4.2.2 Assessors' Scores on Appraisal Forms for ESL Reports 125

4.3 Comparison of Assessors' Scores on Appraisal Forms for the Sample Subset by Category....126
4.3.1 Assessors' Evaluation of NES Reports on Appraisal Forms by Category....127
4.3.2 Assessors' Evaluation of ESL Reports on Appraisal Forms by Category....128
4.4 Assessors' Responses to the Questions on Professionalism....128
4.4.1 Assessors' Responses to the Hiring Question (Q. #31)....129
4.4.1.a Assessors' Decisions about Hiring NES Writers as Junior Engineers (Q #31)....131
4.4.1.b Assessors' Decisions about Hiring ESL Writers as Junior Engineers (Q #31)....133
4.4.2 Assessors' Responses to the Professionalism Category....135
4.4.2.a Assessors' Responses to the Professionalism Questions by Category....136
4.4.3 Results of the Assessors' Judgments about Whether the Report Writers were NES or ESL Students....137
4.4.4 Comparison of the Judgments about Report Writers being NES or ESL Students and the Hiring Decisions by Assessors....138
4.5 Conclusion of Analysis of Assessors' Quantitative Responses....141
4.6 Analysis of Assessors' Comments....143
4.7 Assessors' Comments About NES and ESL Subset Reports Written on Appraisal Forms....143
4.7.1 Number of Assessors' Comments on Appraisal Forms....143
4.8 Assessors' Comments Written on the Appraisal Forms....145
4.8.1 Assessors' Comments Written on Appraisal Forms about Content....145
4.8.1.a Comments on Content in NES Reports....145
4.8.1.b Comments on Content in ESL Reports....148
4.8.2 Assessors' Comments Written on Appraisal Forms about Organization....152
4.8.2.a Comments on Organization in NES Reports....152
4.8.2.b Comments on Organization in ESL Reports....153
4.8.3 Assessors' Comments Written on Appraisal Forms about Format....155
4.8.3.a Comments on Format in NES Reports....155
4.8.3.b Comments on Format in ESL Reports....156
4.8.4 Assessors' Comments Written on Appraisal Forms about Language....157
4.8.4.a Comments on Language in NES Reports....157
4.8.4.b Comments on Language in ESL Reports....159
4.8.5 Assessors' Comments Written on Appraisal Forms about Professionalism....162
4.8.5.a Comments on Professionalism in NES Reports....162
4.8.5.b Comments on Professionalism in ESL Reports....164
4.9 Summary of Assessors' Comments Written on Appraisal Forms by Category....168
4.10 Comments by Assessors Written Directly on Reports....168
4.10.1 Number of Comments by Assessors Written Directly on Reports....168
4.10.2 Assessors' Comments about Content Written Directly on Reports....170
4.10.2.a Academic Assessors' Comments about Content Written Directly on Reports....170

4.10.2.b Industry Assessors' Comments about Content Written Directly on Reports....171
4.10.3 Assessors' Comments about Organization Written Directly on Reports....173
4.10.3.a Academic Assessors' Comments about Organization Written Directly on Reports....173
4.10.3.b Industry Assessors' Comments about Organization Written Directly on Reports....174
4.10.4 Assessors' Comments about Format Written Directly on Reports....174
4.10.4.a Academic Assessors' Comments about Format Written Directly on Reports....175
4.10.4.b Industry Assessors' Comments about Format Written Directly on Reports....176
4.10.5 Assessors' Comments about Language Written Directly on Reports....177
4.10.5.a Academic Assessors' Comments about Language Written Directly on Reports....177
4.10.5.b Industry Assessors' Comments about Language Written Directly on Reports....179
4.10.6 Discourse Analysis of Comments Written by Assessors about Content....181
4.11 Summary of the Analysis of Comments by Assessors Written Directly on Reports....188
4.12 Reasons Given by Assessors for Deciding Whether the Report Writers were NES or ESL Students....188
4.12.1 Reasons Given for Deciding Reports were by NES Students....189
4.12.2 Reasons Given for Deciding Reports were by ESL Students....191
4.13 Summary Conclusion to the Results of Assessors' Evaluations....195
4.14 Additional Input from the Assessors....196

CHAPTER 5: DISCUSSION....202
5.1 Discussion of Questionnaire Data....203
5.2 Discussion of Evaluation Sheet Results....204
5.2.1 Performance Level Scores by Category....205
5.3 Discussion of Performance Levels Related to Demographic Data....207
5.3.1 Demographic Variables with No Statistical Relationship to Performance Levels and Low Descriptive Interest....208
5.3.2 Demographic Variables with Some Statistical Relationship to Performance Levels and Moderate Descriptive Interest....210
5.3.3 Demographic Variables with Stronger Statistical Relationship to Performance Levels and High Descriptive Interest....219
5.3.4 Kinds of Writing Selected by NES and ESL Students....222
5.4 Discussion of the Assessors' Evaluations....227
5.4.1 Assessors' Quantitative Results for the Sample Subset of Twenty Reports....230
5.4.2 Assessors' Comments about the Subset Reports....233
5.4.3 Assessors' Decisions about Whether the Subset Reports had been Written by NES or ESL Students....241
5.4.4 Additional Input from the Assessors....246
5.5 Limitations of this Research....246
5.5.1 Determining the Size of the Sample Subset versus the Number of Engineer Assessors....246

5.5.2 Extending the Database through the Questionnaire to Students.....247
5.5.3 Stage of Participants' Approximation to Professionalism.....248
5.5.4 Asking the Assessors to Judge Whether the Report Writer was an NES or ESL Student.....248
5.6 Recommendations for Future Research on this Topic.....249
5.6.1 Further Insights Directly from the Participants.....249

CHAPTER 6: CONCLUSIONS AND PEDAGOGICAL IMPLICATIONS.....251
6.1 Summary of the Findings.....251
6.1.1 Analysis of the Writing Project Results.....252
6.1.2 Relationship of Performance Levels to Demographic Variables.....253
6.1.3 Assessors' Evaluations.....256
6.2 Perspectives on Acculturation to Engineering Writing Practices Through Education.....260
6.3 Training in Writing for Engineering Purposes.....268
6.4 Pedagogical Implications for English for Specific Purposes.....274

BIBLIOGRAPHY.....285

LIST OF FIGURES

Figure 1.1 Major Interdisciplinary Focuses in the Research: The Acculturation of ESL Students to Engineering Writing 74
Figure 2.1 List of Terms Used in the Research, in Methodological Order.....93
Figure 2.2 Process Flow Diagram of Methodology.....94
Figure 3.1 Distribution of Scores on the Writing Project compared by NES (n = 109) vs. ESL (n = 93) Students.....96
Figure 4.1 Hiring Rates (as Percentage Means) by Type of Assessor (for NES vs. ESL Students).....130
Figure 4.2 Rate of Hiring Decisions (Q #31; in %) for NES Student Reports Only (Academic vs. Industry Assessors).....131
Figure 4.3 Rate of Hiring Decisions (Q #31; in %) for ESL Student Reports Only (Academic vs. Industry Assessors).....134
Figure 4.4 Comparison of Accuracy in Guessing NES Students vs. Decisions about Hiring NES Students (All Assessors), in %, per Report.....139
Figure 4.5 Comparison of Accuracy in Guessing ESL Students vs. Decisions about Hiring ESL Students (All Assessors), in %, per Report.....140

LIST OF TABLES

Table 3.1 Distribution of NES and ESL Students Across Performance Levels 96
Table 3.2 Kinds of Writing: Order of Selection Frequency 115
Table 3.3 Comparison of Means by Category: All Students (N = 202) vs. Sample Subset Reports (n = 20) 120
Table 4.1 Comparison of Writing Project Results (x/30) with Assessors' Means for NES Students in Subset Only (in %) 124
Table 4.2 Comparison of Writing Project Results (x/30)with Assessors' Means for ESL Students in Subset Only (in %) 126
Table 4.3 Number of Correct Guesses about Whether Reports were by NES or ESL Students, by Performance Level and by Type of Assessor (Academic and Industry) 138
Table 4.4 Comparison of Types of Focuses in Relation to Content Written by Assessors Directly on the Reports 183

LIST OF APPENDICES

Appendix A: Sample Request Letter to Engineering Professors 303
Appendix B: Questionnaire for Writing Project Students 305
Appendix C: Evaluation Sheet: Summer Engineering Report Writing Project 307
Appendix D: Sample Subset of Twenty Reports from the Writing Project 309
Appendix E: Sample Subset of Twenty Reports: Demographic Details 310
Appendix F: Performance Levels and Main Demographic Data for the Sample Subset (n = 20) 311
Appendix G: Sample Covering Memo Sent to Assessors with Set of Sample Subset Reports, Appraisal Forms and Reports (n = 20) 312
Appendix H: Cover Page for the Appraisal Form for Each Report (n = 20) 313
Appendix I: Comparison of Scores on Evaluation Sheets: All Performance Levels (By Categories) 314
Appendix J: Mother Tongues and Performance Levels 316
Appendix K: Countries of Origin by Regional Groupings 317
Appendix L: Performance Levels Related to Time in Canada: ESL Students only (as years of residency or as age) 318
Appendix M: Assessors' totals on Subset Appraisal Forms by Categories 319
Appendix N: Assessors' Answers to the Professionalism Questions (#32 to #36) for the Sample Subset of 20 Reports 320
Appendix O: Assessors' Answers to Question about Whether the Writers in the Sample Subset were NES or ESL Students: By Report 321
Appendix P: Assessors' Answers to Question about Whether the Writers in the Sample Subset were NES or ESL Students: By Assessor 322
Appendix Q: Number of Comments written by Assessors (n = 9) 323

THE ACCEPTABILITY OF WRITING BY SECOND LANGUAGE ENGINEERING STUDENTS: ACCULTURATING TO A PROFESSION

CHAPTER 1: INTRODUCTION AND REVIEW OF LITERATURE

I have been teaching English for Academic Purposes courses to English-as-a-Second-Language (ESL) university students for almost twenty-five years. As a result of my experience, I embarked on an exploration of how to teach ESL students studying in the field of engineering. After diligently reading about the features and requirements of technical communication and discussing engineering writing with engineers, I subsequently developed a course syllabus and created teaching materials, revising them constantly as I discovered more about my students, about their field, and about my role in helping them become competent communicators in it. In my research in the areas of writing, both for first and second language acquisition of this skill, I have attempted to reconcile the focuses on process, product, writer, reader, and context.

In this process of development, I grew increasingly concerned that my ESL students needed much more than English language skills in order to progress in their engineering specialties. As I heard and read more stories about their different levels of success in becoming fully communicative members of the field they aspired to, I worried that their preparation was not adequate. ESL students, and others, were not always integrating into the field of engineering as easily as their technical competence and native intelligence should have allowed. Some were settling into so-called bench engineering[1]

[1] A term provided by an engineer who was also a company executive as an alternative to an often used phrase, technical ghetto, which he felt was commonly used in speaking but seldom referred to in writing. He reported that ESL graduates, as well as a few native English speakers, often found themselves sidelined on the basis of their inadequate writing ability and thus were potentially stymied in their career aspirations.

where their technical proficiency could flourish but their professional development languished. And their linguistic proficiency, although improved by training, was not necessarily the key factor in determining or explaining their level of professional success. I felt I needed to, first, understand more about their own journey towards the point of equivalence with native English speakers in terms of writing proficiency. Secondly, I had to ascertain what characteristics of their writing provoked acceptance or rejection by those most qualified to judge it, namely professional engineers. Learning to write appropriately for engineering purposes means learning how an engineer thinks. I too needed to understand the culture of engineering writing and the assumptions it holds about writing well. The literature on workplace writing supported my intuition that such an understanding was required, especially with regards to minority groups and second language learners.[2]

When I decided to embark on research related to these concerns, I took into consideration logistical practicality and the ultimate usefulness of my findings. The practical research limits were set by a number of criteria: First, I wanted to look at both ESL and native English-speaking (NES) students in order to discover if there actually were differences between their levels of writing proficiency. I was fortunate that I had access to a large number of first and second-year students who were involved in the same writing task: the Summer Engineering Report Writing Project (or Writing Project; see Methodology chapter for full details). This served two purposes: it provided the right population base and produced a large set of reports on the same topic written for the same purpose; and by administering a questionnaire to all engineering students writing this report, I could start to learn what

---

[2] The publication in 1993 of a volume entitled Writing in the Workplace, edited by Rachel Spilka, was a timely confirmation of the usefulness of such a research direction. A number of contributing authors laid out the need for more explicit research on what professionals in the workplace really expected from novice writers and from the academies that produced them. The primary concern was a perceived mis-match between academic strategies for the teaching of writing and the kinds of writing tasks graduates would have to undertake.

background variables may have come into play to explain their current writing competence. Comparisons of NES and ESL demographic data and experiential background might offer a first glimpse into the reasons for possible differences. Finally, in order to determine whether students had produced an acceptable piece of professional engineering text, I recruited professionals in the field and had them assess the students' writing.

In the thesis which follows, the results of my research are presented. They have provided me with a base to change my own assumptions and understanding about technical writing, and about students becoming professionally proficient; I hope they will be of some benefit to engineering students and their teachers.

1.1 Context

What are the factors that explain the acceptability of technical writing by second language students to the professional expectations of their field?

Second language learners intending to be engineers, whether entering an academic context or moving into a workplace environment, must learn to construct text that is both linguistically and culturally appropriate to the field. Competence in the skill of writing is not an inherent ability even for native students and most second language learners face additional challenges. ESL writers need to recognize and master a number of features in the target environment which may constrain their ability to communicate clearly in their academic or professional writing assignments.

The purpose of this research, therefore, is to ascertain the technical writing skills of second language engineering students and those of native English-speaking students, and to describe any differences. In addition, it will seek to identify some of the personal and background factors that may explain the development of writing by ESL students. Finally, the research intends to ascertain the extent of acculturation of engineering student writers to the professional

expectations and assumptions about technical writing as manifested through the assessment of that writing by practising engineers.

A number of related disciplines may contribute insights into issues relevant to the research:

- Educational Issues at the Tertiary Level: Training
- Professional Engineering
- Technical Writing
- Theories on the Development of Writing (L_1 English)
- Second Language Acquisition / Writing within English for Specific Purposes Syllabuses
- Genre Analysis / Acculturation to Engineering Literacy

Each of these areas will be considered briefly in the following sections.

1.2 Educational Issues in the Canadian Context Related to Engineering

There is no generic education system nor a typical workplace culture. Engineering students working in English in North America are surrounded by the peculiar characteristics of both social and professional cultures that have been shaped by socio-political, economic, and linguistic evolutionary forces. The following briefly considers the concepts of education that have shaped the work world which most of our engineering graduates will enter.

Like the United States, Canada has modeled its education system on the Anglo-Scottish systems of the nineteenth century, combining a focus on liberal arts with a pragmatic drive for professional skills and utility (Ben-David, 1977). The foundation of the North American educational experience lies in a firm belief in the individual's right to seek personal success within a system of equal opportunities and freedoms. The Romantic notion of the unfettered independent child, open to choice and opportunity, has

been combined with a belief in the child's inherent rationality and potential for educational progress (White, 1987, p. 40). Thus, interpersonal competition and personal success become the basis for evaluation. Status comes with merit, and merit is earned through personal effort. Cultural learning and socialization to forces outside the classroom are important, but individual success is often evaluated in terms of the cost effectiveness of learned expertise. In short, successful transition to workplace positions is commonly held to be a result of personal abilities and hard work. The evidence of that success rests on the specific products the individual offers to prove competency and qualification for acceptance into a workplace when moving out of the educational culture. A technical report is one such product; the ability to write appropriately in the engineering profession is a basic criterion for acculturation and acceptance into the field.

Unlike Sweden or Germany, where work life is seen as an essential subject and practice within the common curriculum (Nothdurft, 1989), or unlike Japan, where social cooperation and diligence are instilled from childhood (Tung, 1984; White, 1987), North American systems of education generally present a sharp break between schooling and work. This dissonance comes into focus when employers, whether small business or huge corporations, raise concerns about the quality of the available recruits and of their work, including their writing. The reality for engineering students in Canada is that corporate interests and professional expectations demand that engineering education include a strong component of acculturation to appropriate practices. This process of acculturation, which includes learning appropriate writing skills, is expected to be well rooted within the educational system. This is rarely the case.

Like all other industrialized nations, Canada needs a work force that is capable not only of understanding and working with technology, but one that is flexible and adaptable in its skill acquisition to cope with changing economic and technological

demands. Many employers would assert that this adaptability and skill acquisition are not evident to the degree necessary. The dropout rates in Canada (between 20% and 30%) and illiteracy rate (20%) are considered alarming (Wilkinson, 1994, p. 9). Even worse, the disaffection that many young people feel for education and for work is balanced with the frustration that educated graduates feel when they can't find employment that matches the knowledge or abilities they have gained. Up until the last decade, the lack of training opportunities in Canada has been the result of poor education-industry cooperation in this area, with the exception of some technical cooperative programs (National Advisory Board on Science and Technology, 1994). Traditionally, corporate support for training has been very low and there have been fears that government cutbacks and private corporate interests will hijack the public's right to accessible and equal education (Calvert & Kuehn, 1993). However, increasing governmental interest in education and the creation of an appropriately trained work force to promote the general economic good is reflected in recently initiated corporate-education initiatives and expanded cooperative programs, as demands for skilled graduates grow[3]. Part of this new cooperative initiative is a concern for well-developed communication skills. The recognition that a centralized vision is required to support a positive work culture and build self-reliance and initiative in youth is evident, for example, in the numerous government and private commissions that have looked at the school-work situation (such as the many reports sponsored by the Canadian Government through its Steering Group on Prosperity) within the last ten years. For example, one federal government report on the quality of education-workplace transition by the Committee on National Standards in Education (1994) addresses the need for national standards in Canadian education and training programs, national testing programs, and improved apprenticeship programs. Responses to these calls for standards are echoed in the certification programs regulated by

[3] Both the Canadian and Ontario governments have recently (February 2000) announced additional funding for secondary education, primarily aimed at the high technology training required by corporations.

professional engineering associations, such as the Association of Professional Engineers of Ontario (L. Fogwell, personal communication, December, 1994), who evaluate the writing as well as technical expertise of their candidates. These are the broader academic-industry contexts that engineering graduates, including second language students, will encounter.

Increasingly, Canada is integrating a multicultural work force, along with internationalizing its business interests. Cross-cultural interactions may require corporate adjustments. The concept of continuous or life-long learning has been set forth as one necessary attitudinal and systemic shift in order to cope with these changes. Canada must create both domestic harmony and global strengths with skills and a vision that take the best advantage of its human capital. This means ensuring that all graduates, regardless of mother tongue, are equally prepared to deal with the full range of requirements in their chosen professions. This includes promoting the development of appropriate writing skills through efficient and insightful language training.

1.2.1 Educational Issues for Second Language Learners

Second language learners who are studying within a particular field face the same methodological, pedagogical and administrative constraints as do mother tongue students in that subject area. In addition, however, second language users may experience constraints peculiar to their own situation due partly but not solely to a lack of facility in their second language. The requirements of second language engineering students, like those in other professional groups, can also include the need to adapt to the general academic demands and expectations of North American university and professional milieus. Understanding to what degree second language students succeed within these areas will require a description of the specific demands placed upon them. Woods (1987) for example, summarizes the kinds of problems immigrants and refugees face in attempting to pursue higher educational goals in

Canada, which include such obstacles as TOEFL (Test of English as a Foreign Language) or other English language exams, unfamiliarity with procedures, over-concentration by ESL students on maths and sciences in high school to the detriment of English language experience, and socio-cultural adjustments, particularly in relation to academic demands such as writing and managing tasks appropriately. Other issues related to adult education in tertiary training programmes include human resources planning, accreditation and evaluation (Brown, 1991; Freedman, 1987; Jaeger, 1988; Huberman & Miles, 1994; Patton, 1990; Swales, 1990; and Woods, 1987). Accreditation for engineering certification, for example, is a provincial concern and includes a test of writing proficiency in addition to the exam for technical competence for all candidates, as well as a language requirement for non-native speakers of English. The tension between general educational processes in Canada and the requirements of professional certification mean that the transition from academia to workplace may be a difficult one when coupled with additional second language constraints. Yet the general dissonance between the need for discipline-appropriate writing skills and the educational preparation for such writing is not limited to second language learners, as the following section explores.

1.2.2 Industry Needs: Students' Expectations

Industry needs for good writers and engineering students' assumptions about the requirement for writing do not always harmonize. The majority of undergraduate engineering students seem to hold the view that writing will not be a significant feature of their future work nor a way of learning their discipline (Beer, 1992; Kalmbach, 1986; Knapp, 1984; Michaelson, 1984; Winsor, 1996a). Yet one of many surveys, described in Barnum (1982), reveals that:

> [P]rominent engineers spend almost one-fourth of their time engaged in technical writing and another 31 percent reading technical materials prepared by others. These engineers

> attribute their advancement largely to their ability to communicate well. They bemoan the poor quality of much of what they have to read. Finally, they recognize the need for required courses in technical writing for engineers. (Barnum, 1982, p. 136)

One issue that is fundamental to the discussion on technical writing is the fact that it is an essential and not peripheral skill in the profession. Many first language engineering students are not aware of the centrality of writing to professional tasks and its role in problem solving and transactional activities (Artemeva, 2000; Kalmbach, 1986). Many second-language students (who may have chosen this field partly for its apparent non-language intensity) may emulate their first language peers' disregard for the importance of technical writing.

Simply taking engineering courses will not necessarily help students to approximate industry standards either. Indeed, one researcher, discussing the use of lab reports, claims that

> ...by their very nature as training grounds, engineering classes establish a misleading context for writing. Through the writing done for these classes, students learn to ignore their readers, to misunderstand the purpose of the writing they will do on the job, and to misconstrue the crucial process of revising their texts....[On the other hand], the messages from...engineers have consequences. Effort, time, and money are expended on the basis of the engineer's words. Words that are misleading, ambiguous, or imprecise yield bad decisions, improper actions, wasted efforts. Or perhaps the engineer's words are unclear or confusing, and so the information is ignored. More waste, more error. (Gwiasda, 1984, p. 149)

This rather lengthy lament, which continues with the exhortation to engineering professors to continue in their efforts to teach clear writing, illustrates the kind of mutually unsupportive triad often reported to exist between engineering student,

engineering professor and industry practitioner. Getting students to write lab reports and short assignments promotes the ability to write for the already informed, rather than teaching them how to inform. Engineering professors seldom have the time or inclination to develop their students' writing ability to match industry practices, especially in their overloaded undergraduate programs (Winsor, 1996a). This has been a long-standing concern; Knoll, in 1969 expressed the view that

> ...hardly anyone is willing to admit how difficult it is to produce first-class technical writing, certainly not most teachers and administrators (who by and large are not much good at it themselves). There is a failure to recognize how much talent, knowledge, and stamina are needed. (Knoll, p. B-167)

Georgopoulos and Georgopoulos (1984) investigated the

> ...university-industry written communication gap.... Unfortunately, most university programs do not adequately help students with technical communications. Consequently, the new engineer, when hired, [has] the burden of overcoming the gap of technical writing, apart from his other important engineering tasks. (p. 144)

Engineering professors and university engineering program administrators who may recognize the need to develop their students' communication skills tend to drop the issue as they battle common budgetary and curricular constraints. The problem is to identify both the nature of the attitudinal discrepancy presented above and the benefits of installing a technical writing program within an engineering curriculum. What should be done to make the oppositional triad a supportive tripod?

1.2.3 Lack of Relevant Writing Experience

Undergraduate students who have seldom written or have only produced literary or self-expressive essays simply do not have the experience of technical writing as a separate genre distinguished by more than underlined titles and spaced sub-sections. Sometimes report models are presented in lab sessions but are often perceived as fill-in-the-blank exercises in which points of view or recommendations play no, or at most a minimal, role. Furthermore, in the typical undergraduate lab report, most procedures and results are determined or already known by the instructor, the style of presentation is pre-set, and the information produced by the student is seldom new or controversial (G. Hartley, professor of civil engineering, Carleton University, personal communication, February, 1994). Engineering students who write class assignments are generally conscious of a pre-informed audience and marker rather than a true reader waiting for information. This orientation does not give students the necessary awareness of supervisory or client expectations, nor does it prepare them for the focused selection of relevant content to serve specific reader needs. As Mitchell and Taylor (1979) put it so succinctly: "The audience not only judges writing, it also motivates it" (p. 6).

An additional problem is that many students enter their engineering programs with the belief that

> ...the course requirement is to master numerical problem solving procedures. It is not. The task is to understand concepts well enough in order to solve problems. Students who enter the exam room, having spent the term studying solved problems (and not the principles), and who have spent their tutorial time asking teaching assistants "what?" rather than "why?" face a much more serious problem than failing the exam--they may pass it and go on to a more advanced course, without having mastered the basics....I think you will find that the problem is much more serious than one of literacy.

(Professor Gil Hartley, Carleton University, Ottawa, personal communication, July 1994)

Further:

> In our courses there are no essays, and rarely exam questions or assignments requiring full sentences. In the senior year of the program, we expect students to be able to prepare reports for projects or labs, using a mode of communication which they have never had the opportunity to practise, involving new concepts, new jargon and new procedures. To an engineering faculty member, the writing demand seems easy. To the student who has not had the opportunity to practise this, it is very stressful, since a non-precise response is basically a wrong one. (G. Hartley, Ibid.)

Undergraduate engineering students must learn not only how to solve problems through language but also how to frame those solutions in writing genres that approximate professional forms. Yet few opportunities are provided within their engineering programs to generate or learn how to create these forms. Cope and Kalantzis (1993) summarize the need for appropriate workplace writing skills:

> Students are moving into the workforce which, with industry restructuring, requires fewer and fewer unskilled workers. Moreover, the nature of technological change and the changing nature of technology are such that written texts--reports, procedures, arguments and the like--are becoming an increasingly important element of working life. If education is to remain relevant simply to the work requirements of students who may later find employment in science-based industries, and if literacy learning in school is to give students the discursive tools to rise to higher levels in the workplace hierarchy than they might otherwise have reached, then learning science needs to be viewed quite explicitly as a discursive as well as a technical process of cultural induction. (p. 12)

1.3 Characteristics of Technical Writing: What do we need to know in order to best prepare ESL students?

"Writing is the bane of engineers; we are almost proud of doing it badly."

L. J. Kamm (1991). Real-World Engineering, p. 50.

A commonly held view of technical writing is that it differs in significant ways from so-called traditional academic writing. Academic writing focuses more explicitly on expressive, persuasive or argumentative rhetoric, designed to provoke thought as much as to inform or promote action (de Beaugrande, 1982, Geisler, 1994; Hamp-Lyons, 1991). Technical writing tends to function as part of work, oriented towards informing but also tending to require action. Yet for many years there had been no clear consensus on how these differences in technical writing are manifest, nor to what extent they are extricable from the tasks technical people do.

The communication skills required of professionals in the technical fields cover oral, graphical, mathematical, and verbal modes. Technical writing constitutes a large proportion of this communication repertoire, and it has attained an identity in contrast to academic or other forms of writing. The definition of technical writing varies with the focuses applied. Several of these different views are discussed briefly below.

1.3.a Subject Matter Focus.

Most frequently, in popular terms, technical writing has been defined by its subject matter. Technical writing has been interpreted as being any kind of writing that deals with subjects in science, technology, engineering, or business. In this subject-matter emphasis, however, both the shape and the shaping of technical communication are rather loosely defined. To define technical writing primarily by its themes is not only to miss its singularity but also to obscure how its shape is created and refined. Expository technical writing can be creative, while expressive writing can

dwell on technical matters without being accepted as technical writing. Even if the subject matter is narrowly restricted to scientific and engineering topics, this tells us little about how to characterize the communication itself.

1.3.b Objectivity.

Some technical writing textbook authors have insisted on defining technical writing on the basis of its formal features such as specialized vocabulary, conventionality of reporting modes, the complexity of its communication tasks, and its objectivity (Andrews & Blickle, 1978; Beer, 1992; Hays, 1975; Mills & Walter, 1954). Complexity can lie not only in the technical tasks but can also lie outside task-specific considerations; for instance, it may lie in the message or in the purposes for which the document is written. How a technical writer comes to understand and create text for specific purposes and audiences is a complex process since it relates to the nature of the information as well as the context in which it is produced and disseminated.

Objectivity has remained a consistent feature of common definitions of technical or scientific writing, despite the increased focus on implicit persuasion inherent in the linguistic and rhetorical choices made by technical writers. Objectivity has been perceived, for example, in the linguistic choices that constitute the text. Technical writing is said to differ from non-technical writing as a result of the preponderance of certain neutralizing or distancing structures in lexis and syntax. Thus we find the insistence on passive or other agent-less verb constructions, on the avoidance of personal pronouns, on the lack of expressive or personal voice, and on the increased use of abstraction (See the manual by Beer, 1992, for example; or Blake & Haroldsen, 1975; Mills & Walter, 1954). In many ways, however, the call for objectivity remains a conventionalized device, even while more recent researchers in rhetoric are uncovering the more persuasive aspects of technical writing (Bernhardt & McCulley, 2000; Winsor, 1996a).

1.3.c Vocabulary.

Other definitions of technical writing have stressed vocabulary as a major feature, both its specialized nature (typically called jargon) and its use of non-technical words (Ford, 1974). Hays (1975), for example, describes the conservative nature of English technical writing's "Teutonic" subject-verb-object word order (see also Tebeaux, 1980), and its sharing of common vocabulary, although he emphasizes the double or triple meanings that so-called common vocabulary may have in technical fields (Think of moment shear, conductor, de-bugging, or capacity, for example). In addition, despite the insistence that technical writing ought to avoid obscure or literary references and metaphor, examples of technical texts show a remarkable use of metaphors, similes and analogy in an effort to clarify the new by reference to the known (Bush, 1991) (Examples include S-curves, A-frames, female coupler, hands-on). The difference in technical writing seems to rest in the precision of the lexical choice in a given context; technical writing does not like to be vulnerable to any free interpretation by the reader.

1.3.d Linearity.

Technical writing is seen as a linear presentation of data very unlike the frequently recursive, complex, and unpredictable flow of expressive writing. Technical writing orients subject matter rather than the reader, even while the reader's needs are the focus of the decisions made in the presentation of the message.

1.3.e Different Formats.

Technical communication is significantly varied in comparison to academic prose. The variability of form in technical documents generally corresponds to conventionalized expectations related to topic treatment, audience and register (Beer, 1992; Blake & Haroldsen, 1975). The diversity of technical writing results from its need to engage in information exchange with a vast array of readers and contexts. Technical writers must create text that is flexible enough to meet various readers' demands even while maintaining a

systematicity of form. Thus, technical memos, reports (very wide-ranging in purpose and styles), flow charts, proposals, operations manuals, specifications, and so on, are uniquely formatted and distinct within their discourse communities. They are constructed in specific ways to suit the needs and uses of people who are mutually comprehensible in their goals and writing practices.

Finally, definitions of technical writing must now incorporate new formats and conventions related to technology. Telegrams, facsimile machines and, of course, computers and the Internet, have created the need for unique linguistic codes and styles for on-line communication. In addition, instructions/specifications on how to use the new technologies have developed peculiar reading and writing requirements as well as re-considerations of the processes of composing and revising (Mehlenbacher, Miller, Covington & Larsen, 2000; Woolston, 1984).

1.3.f Graphics.

In addition to vocabulary choice, brevity and variety of discourse units, there is general agreement that technical writing is visually distinctive. Assuming the need for explicitly signaled organization of conceptual units, technical writers employ headings, sub-headings (usually numbered) and auxiliary graphics of all kinds (including mathematical and formulaic) to orient the reader and organize the message. In some written presentations, graphic data is predominant over linear text.

1.3.g Rhetorical Functions of Technical Writing.

Despite claims for objectivity, the selection and highlighting of information in a technical text can be highly subjective and persuasive, depending on the objectives and audiences in mind (see Gilsdorf, 1992). Descriptive, sometimes prescriptive, definitions of technical writing often emphasize aspects of format, form or lexis. Discourse and rhetorical functions, on the other hand, look to logical conceptual relationships as expressed through syntax. Grammatical choice and rhetorical patterns are central to considerations of

register or to concerns about levels of formality and internal consistency of a style of writing (Fairclough, 1992; Ferguson, 1994; Gregory & Carroll, 1978; Halliday, 1988).

Technical writers in engineering tend to follow the convention of apparent rhetorical neutrality even while they are explaining, recommending or directing an action and fully aware that their writing carries persuasive weight (Winsor, 1996a).

The selection of linguistic and non-linguistic devices therefore requires a conscious understanding of discourse choices and rhetorical frameworks from which to create the intended effect of disengaged interest, even while commanding attention with the persuasiveness of the data and linguistic selection. To attempt to either explain or assess a writer's product, the reader also must keep purpose in mind.

Fry (1987) reviewed five years (1981-1986) of contributions to the IEEE Transactions on Professional Communication in which he noted that the professed purposes and intended audience of the periodical had shifted from "describing technical communication as an art in itself to developing technical communications in the engineer's tool chest" (p. 4). Contributors demonstrated increasing awareness of the complexity of reading purposes in the engineering workplace, the diversity of audience, reading ability and technical expertise, and that the engineer's writing task involved "major considerations of purpose and audience, more than minor considerations of organization and style" (p. 4). Within this survey of technical writing research a focus on product (mechanics, organization and style) had been supplemented and even supplanted by consideration of the writer's awareness of task orientation and intended readers.

Fry showed that an emphasis on logical and critical thinking skills replaced the adherence to prescriptive checklists or one-dimensional models. Increasingly, the writer's determination of audience and purpose has become a flexible process that extends

throughout the whole composing activity, from planning to prewriting to writing, revision, and polishing or formatting. Furthermore, the increased use of collaborative writing teams for specific projects has highlighted the need for coordination of writing styles and formats.

What technical writing is, therefore, depends not only on which of its many aspects (topics, lexis, syntax, format, rhetorical features, register) are emphasized, but also on how and why it is constructed and received. Second language writers in transition to a profession must therefore not only learn how to make linguistic choices but also how to frame them within the goals and constraints created by the whole context for writing. Recognizing that the engineering discourse demands a particular way of writing is the first step. As Widdowson (1998) puts it:

> It is generally accepted that communities or secondary cultures which are defined by shared professional concerns should be granted rights of ownership and allowed to fashion the language to meet their needs, their specific purposes indeed. And these purposes...are two-fold: They are communicative in that they meet the needs of in-group transactions, and they are communal in that they define the identity of the group itself. (p. 243)

1.3.1 Engineering Writing as a Way of Thinking

While some technical writing experts describe surface features and others focus on rhetorical functions relating to writer-reader relationships, still others prefer to concentrate on the type of thought process involved, distinguishing, for example, between associative thought, connected to the humanities, and the sequential thought of mathematics and science (Britton, 1975). Knapp (1984) similarly divides writing into imaginative (personal, evocative) literature and functional (factual, reasoned or inferential) literature, the latter used by technical and scientific authors to

impose a limited way of thinking on the reader. Britton (1975) extends the notion of restricted interpretation when he states that the "primary, though not sole, characteristic of technical and scientific writing lies in the effort of the author to convey one meaning and only one meaning" (p.11). Hayakawa (1980) concurs when he insists that reports adhere to the rules of strict verifiability and exclude inferences and judgments. Precision and neutrality are apparently valued characteristics in technical writing.

The view of technical writing as serving particular functions looks to its role of providing precise and accurate information such that specific action is described or undertaken. This assumes that an explicitly stated purpose of the communication acts as a guide for both composer and reader; there is the additional expectation that the audience (whether single or multiple) has been accurately targeted and that this is reflected in appropriate style, format, and choice of language (Selfe, 1983).

Woolever (1990) has analyzed the differences between academic and technical writing and suggests that the rules of technical discourse include the following:

(1) present the facts in deductive order;
(2) write in a denotative fashion, reducing the opportunities for reader interpretation;
(3) write in a decisive tone, so that the reader is not invited to help determine the end results; and
(4) design the page to increase efficient readability and quick reference (p. 9).

Winsor's (1996a) study of how novice engineers struggle to develop a sense of rhetoric through the decisions they make about writing also discusses the nature of learning how to think like an engineer.

> The rhetorical nature of engineering writing and engineering work is not obvious at first glance, at least not to students.

> They tend to think of engineering as a matter of knowing something and perhaps as a way of doing something. The fact that knowing and doing happen in concert with other people seems like a minor detail. Technology seems data-determined and unarguable. As a profession, engineers frown on persuasiveness and find it suspect. (Winsor, 1996a, p. 12)

There are, in short, fairly well-defined notions of what engineering writing ought to look like and what conceptual routes it ought to seek. Learning these rules is important for both native English-speaking and ESL writers. However, ESL writers may be further constrained by culturally distinct ways of thinking and organizing ideas when making judgments on appropriacy in their writing.

1.3.2 The Role of Writing in Engineering

Engineers use their knowledge of mathematics, physics, chemistry, and the other sciences, along with computer skills, to solve practical problems in the physical world. The role of writing in this problem-solving orientation is not always apparent to engineering students, especially when their programs do not emphasize communication. However, the view that writing abilities are secondary to technical preparation has now been undermined by insistent calls on the part of employers for effective communication skills in graduating engineers ("Graduates technically competent, but weak in communication skills," 1987; Tebeaux, 1996). Two major rebuttals to the anti-writing position have been made: The first states that most engineering activities require writing and that the construction of knowledge comes about partly because of the solving of problems through language and not prior to language. Secondly, engineers do not simply solve problems; they solve problems for people, for a purpose, to initiate thought or action. They do not write in isolation or for self-expression; all their power rests in moving ideas outward and establishing a network of relationships. This interdependency of engineers with managers, clients, colleagues,

and the community can only be maintained through communication. Whether student writers are aware of these roles becomes apparent as their critical readers comment on egocentric versus audience-oriented style (Winsor, 1996a).

As Dorman and Pruett (1985) point out, there is a close relationship between writing and engineering:

> The writing process, like the engineering process, includes information gathering, sorting, analysis; conscious and subconscious attempts to connect the information meaningfully; the development of a solution; applying that solution; revising and correcting for error. Writing is a way to think, a process and an essential part of the engineering process. (p. 656)

Some researchers in the field of technical writing research view thinking about the subject matter and writing about it as essentially the same process:

> There is reason to doubt about whether writing in its complete sense can ever be taught as such, because its essential mental processes are really integral with the subject matter. In other words, the man who knows his business and is well organized is at the same time almost automatically prepared to write or speak about it. A really complete writing course would then have to concern itself with the student's understanding of his trade or profession. (Johnson, 1975, p. 51)

However, although there is some self-evidence in the idea that expertise confers automatic preparation to write about it, knowledge of subject matter and the proper communication skills to present that knowledge are not always in an automatic partnership, as proven by the number of professors and professionals who lament the lack of communication skills of even their most gifted engineering students or junior members of the profession (Knapp, 1984, Michaelson, 1984).

The development of effective and focused skills in written and oral communication is encouraged, furthermore, for career enhancement reasons: better writers move ahead (Andrews, 1981; Beakley & Leach, 1979; Collins, Ghey & Mills, 1990; Day, 1992; Knapp, 1984; Kemper, 1985; Mathes & Stevenson, 1976; Olsen & Huckin, 1991), as attested by statements such as the following:

> The experience of practising engineers bears out the correlation between writing skills and successful careers. Engineers who write well advance in rank, eventually reaching management levels. Those who cannot write tend to be passed over for promotions and remain in routine jobs. Junior engineers may find writing requirements minimal during the first year or two of practice, but as they gain expertise, they are increasingly required to communicate that expertise. Those who can do so are promoted to more challenging, better paying positions. (Knapp, 1984, p.10)

> ....[T]housands of people who earn technical, legal, and scientific degrees, move into management and find not only that they must write as part of their jobs, but also that promotions frequently depend upon their ability to communicate clearly and exactly....[Two] elements--one technical and one attitudinal--by fueling each other, sabotage the writing of many otherwise competent people. (Aldrich, 1982, p. 284)

> Writing is a professional necessity. It is problem solving in written form and creates order from chaos (the essence of engineering). We neither can nor have to afford the luxury of producing engineers who cannot write. (Dorman and Pruett, 1985, p. 658)

Proper communication skills play a prominent role in an engineer's advancement: "Engineering department managers usually place communication skills high on the list of criteria for a promotable engineer" (Michaelson, 1984, p. 152). Decreased job security may be

an extreme consequence of poor workplace writing, but a lack in these skills may have other effects: "...[T]hough their ideas may be good ones, ...[some] engineers lack the communication skills necessary to get their projects funded" (Burke, 1984, p. 25).

In order for engineering students to successfully attain full professional status, they must understand that strong communication skills will play an important role in their career. In a Canadian context, a discussion of the importance of writing skills of engineering students or novice practitioners inevitably entails the issue of second language writers and whether their technical competence is accurately reflected through their ability to write. Students whose first language is not English constitute anywhere from one-third to over one-half of the undergraduate engineers enrolled in Ontario universities; these ratios vary across Canada and across undergraduate compared to graduate programs. Most universities do not restrict the admission of second-language students except in the issue of language proficiency; these ESL students can compete with Canadian-born students for entry into the same programs. Many ESL students succeed. However, many others whose mother tongue is not English often face a problem even once they have gained admission to university. They may have proven their academic capability, despite any second-language constraints, in order to have won admission. However, once in their programs ESL students often find that the language skills and general academic preparation that brought them into the system are not always sufficient to help them progress successfully through their programs or to graduate.

In the case of ESL engineering students, the full impact of inadequate language and educational preparation for writing demands may not be felt until the end of second year or even into the third, when more language-intensive or problem-solving courses are taken. The math-heavy loads of first year do not usually, with few

exceptions,[4] provide the opportunity for students to demonstrate control of clear, well-focused and accurate writing strategies. In addition, the lack of experience with different kinds of writing (or different genres) in engineering, an inexperience which many native English-speaking students share, is not offset by the same kind of implicit cultural awareness of appropriacy that native speakers can turn to for guidance. Many ESL students who depended on non-language skills and knowledge to get into their programs have no back-up system to turn to in the process of writing when awareness of culturally-based assumptions (in both academic and professional cultures) is limited.

Coherent, well-focused and effective writing skills are an integral part of an engineer's professional activities. Such skills are not always apparent in the novice practitioner, especially the ones with ESL backgrounds. In order to facilitate the acculturation of ESL engineering students to writing in their field, it is important to first select an appropriate model for the development of effective writing skills in general. Much of the research on writing for English-as-a-second-language students rests in the theoretical developments in English first language research in writing. A brief overview of the main trends in that field of study is therefore useful before considering the specific elements of the writing competency of ESL students who need to learn to write as engineers.

1.4 Theories on the Development of Writing

In the field of composition theory and writing research in English, first language, there have been a number of paradigms (in the Kuhnian sense) which have attempted to describe the nature of writing, the developmental processes of writers, and what constitutes competence in this skill. One of the major distinctions that persists in the field is that between product and process. The

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[4] Professor G. Hartley of Carleton University, Ottawa, for example, has been incorporating small writing tasks into his engineering courses for several years simply to promote students' awareness of the need to learn to describe data and concepts clearly.

primacy of the one focus or the other has oscillated in conjunction with the theoretical position held at any one time. Theories and models for second language acquisition, although set within a linguistic field, have evolved in response to advances in other areas as well. Similarly, the theoretical views on writing have been linked to developments in related fields, primarily in psychology and education, as well as rhetoric and ethnography. And like second language acquisition studies, these views have not evolved in a purely sequential fashion, but have spiraled and been reintegrated in somewhat different guises as perspectives and emphases have shifted. The various approaches taken by writing researchers in English are now reviewed in relation to the trends in research on technical writing.

1.4.1 Behaviourist and Early Cognitive Approaches to the Study of Writing

Behaviourist researchers (e.g., Skinner) stressed the stimulus-response aspects of writing, while the early cognitivists (e.g., Chomsky, 1966) stressed the knowledge of underlying rules to explain competence.

In the first half of the 20th century, positivist or behaviourist psychology suggested that products (conceptual, physical, or biological) could be examined in light of reactions to particular changes in the environment or in the web of interrelated variables surrounding an event. By systematically altering input variables (stimuli), one could supposedly predict output (responses). This kind of scientific approach underlies much of the communication studies that directed initial research on technical writing. The scientific study of the communication process assumes that knowledge about the components of this process will illuminate the overall event. Communication involves intellectual (informative), emotional (persuasive) and entertainment properties, the primary purpose of which is to produce a response. A communication model involves the following components (which define behaviours, not necessarily

individual entities): a source/sender (with a purpose); a message; an encoder (i.e., voice, gestures, script); a channel (medium); a receiver/decoder, or the communication receiver. The communication model assumes that the components of the process are analyzable in terms of behaviour. Through the manipulation of either descriptive or operational features, the written outcomes can be affected. This model does not delve into the writer's mind or consider the recursive and developmental stages of the act of composing. This communication process model is still evident today in instructions to students of technical writing, in which considerations of goal, audience and style of message are presented in a checklist and recommended as objectives in planning. In most of these instructions, an underlying assumption about the instructor-writer-reader's cultural and professional homogeneity precludes explaining these aspects to the novice writer, especially in regards to audience or setting.

The behaviourist (basically Skinnerian) approach to writing emphasized gradated development of competent performance. By the teacher's controlling for mistakes, a writer could be taught to produce the correct forms required by specific situational conditions. Prescriptive rules were the basis for writing instruction on all aspects of structural accuracy (Rose, 1998). De Beaugrande (1982) describes the behaviourist approach, which he terms "physicalism" (p. 212), as one in which the speaker/writer acts as passive or disengaged bystander subject to environmental controls. He describes the decision-making processes whereby composition is created in response to appropriate stimuli, and where fluency develops by tapping the previously conditioned fluency of speaking, Yet he notes the inefficiency of behaviourist techniques in developing appropriate writing skills (p. 215).

The cognitive approach crafted by Chomsky, in contrast to behaviourist approaches, placed emphasis not on external stimuli but on the analysis of underlying rules, the competence of an ideal speaker-hearer. Written performance would inevitably be flawed

since it occurred in external reality. Regarding what he terms Chomsky's "mentalist" approach, de Beaugrande asserts it was very selective in its description of language processing, basing its view of mental processes primarily on syntactic logic within a Cartesian framework (de Beaugrande, p. 222). Instead of embracing Chomsky's view of a neutral, abstract and disconnected competence, de Beaugrande prefers instead to focus on performance, with its social, cultural and interpersonal connections. To express complex ideas clearly in writing, de Beaugrande states, students will need decision-making procedures that take account of context and intention, a demand "that can never be met by a theory in which the 'grammatical sentence' is presupposed as the central notion, and the only 'processes' are syntactic conversions" (p. 227). De Beaugrande does, however, agree that it is important to discover the mental reality underlying actual behaviour (p. 228).

1.4.2 The Current-Traditional Approach to Writing.

Before turning to cognitive approaches to writing, this section will briefly consider one of the theoretical frameworks that dominated writing research during the early part of the twentieth century, namely the so-called "current-traditional" paradigm (Freedman et al., 1983, and Hairston, 1990). The emphasis on the composed product allowed a descriptive focus to develop. Writing in the current-traditional approach involved the sequential application of prescriptive, product-oriented analyses, including the consideration of goal and audience, which determine the selection of discourse signals (see, for example, Beach & Bridwell, 1984; Hairston, 1990; Witte, Nakadate & Cherry, 1992).

According to descriptions of writing presented through this model, the emphasis is quite firmly placed on the composed product rather than the composing process; on discourse analysis of words and sentences; on the classification of discourse into rhetorical functions (description, classification, etc.); and on a concern with correct usage and style. In this model, invention and the creative

processes of free writing are suppressed in favour of conscious control by formal procedures, a "linear composing process that proceeds systematically from prewriting to writing to rewriting" (Hairston, 1990, p. 5). It is assumed that the writer already has the ideas under control and simply needs to be guided procedurally through the transcription of these ideas.

This current-traditional approach to the production of text is focused on surface correctness. However, the extent to which a learner had adhered to structural aspects of language and to rules regarding the appearance of the written product does not reveal to a writing researcher how the writer has understood or accomplished the task. Writing in the current-traditional approach is the sequential application of prescriptive, product-oriented analyses, including the consideration of goal and audience, which determine the selection of discourse signals.

Witte, Nakadate and Cherry (1992) point out that classical rhetoric was indisputably a male-dominated, hierarchical system, and early-modern rhetoric's focus on discourse features continues to reflect the values of dominant groups, whether in mainstream or cultural terms, or in terms of professional or discipline-specific norms (p. 4). Many of the approaches to technical writing, even today, still reflect just such an orientation (as evidenced in technical writing manuals produced by professional engineering associations), where the emphasis is on audience analysis and linguistic selection as well as the shaping of surface textual features to fit common standards. In some studies in English for Science and Technology (EST), undertaken first by those concerned with second language acquisition within the current-traditional framework, analyses of the relationship between specific grammatical forms and rhetorical patterns have become the basis for pedagogical focuses. Some of these prescriptive manuals and pedagogies are giving way, however, to the more descriptive social approach towards rhetoric. The immediate responses to the behaviourist and the current-traditional approaches to writing have

been quite different. One response has been a revision or re-framing of rhetoric itself, while another response has turned its focus inward towards the mental processes operating in an individual writer. The following first considers the so-called new rhetorical approach.

1.4.3 The New Rhetoric

A consideration of written discourse features predominate in the new rhetorical approaches developed in the twentieth century. The early descriptive, sometimes prescriptive, definitions of technical writing emphasized aspects of form, while current discourse and rhetorical functions look to logical conceptual relationships as expressed through syntax. Analyses of text types, of types of discourse (argumentation, description, classification, narration, exposition, etc.), and of discourse markers within text that signal logical relationships both at the macro- and micro-structure levels and create coherence, unity and emphasis continue to form the basis of this focus. By re-incorporating aspects of classical rhetoric which had not been part of the earlier prescriptive emphasis on form, the new rhetoric has broadened its focuses to encompass ethical, social and personal considerations. With this re-focusing has also come new ways of looking at genre and register (cf., Frederiksen & Dominic, 1981; Freedman, 1983; Hairston, 1990; Witte et al., 1992, for example).

The focus in most of the earlier modern views on rhetoric remained on the effect on product of various linguistic choices. This importance of the relationship between writer and reader echoed the behaviourist stress on stimulating the receiver for the appropriate response. However, the difference in the modern rhetorical viewpoint lies in an increased importance on the selection procedures (both psychological and methodological) by which the writer induces this response. Less emphasis is placed on factors internal to the composing process or to the writer. Instead, the

external effects of the selection and organization of words are analyzed in relation to the broader context of writing.

Rhetoricians in the new rhetoric framework are concerned with the process of composition, but this process is still partially product-oriented in that it looks at how writers go about finding, developing and framing propositions in order to produce certain effects through their text. The emphasis is on how the writer's behaviour moves ideas towards the intended reader. In this orientation, the technical writer is advised to keep purpose, audience, context, and style in mind and to choose the most appropriate methods by which to generate and frame the content.

Rhetoric therefore becomes the study of effective choices among linguistic and discursive alternatives. Meaningful choices become refined in a purpose which is often grounded in a specific external and systematized context. The notion of audience as a focal point for a writer's composing strategies has grown beyond its early rhetorical emphases on proper forms of address or level of formality to an increased awareness of the multiplicity of audience types, of 'real' readers, the 'reader in the writer' and the 'reader in the text' (Selzer, cited in Witte et al., 1992). Widdowson (1983), among others, has also insisted on the primacy of the writer-audience relationship, relating it to the schemata, or frames of internal representation of knowledge, held by both reader and writer.

In contrast to assumptions regarding product in usage-oriented style manuals or even mode-oriented rhetorical instructions on narration, description, exposition and argumentation, there is now more emphasis on purpose in discourse, specifically how purpose shapes the choice of diction, syntax or mode. Technical writers such as engineers seldom write to simply express personal feelings or opinions. Instead they write in order to explain something to someone, or to persuade or to recommend an action (or combinations of these goals), with directions grounded in the hard data they attach. In this model of writing, there is a greater emphasis on the writer's rhetorical and linguistic decision-making.

For second language learners, conscious analysis, whether as writer or as reader, is dependent upon an understanding of not only professional norms but of differential linguistic values in the base culture in which decisions are made. One of the recurring types of comments in the literature within this perspective deals with a writer's inability to address the intended audience accurately or to engage in a reader-centered approach. Poor writers frequently produce writing that is overly egocentric in its presuppositions about topic and so does not anticipate readers' questions or needs. This has been a comment about second language writers as well (Hamp-Lyons, 1991).

The technical writer must often aim to inform a number of audiences who are differentiated not only by their specific purposes for reading the text or their projected responses to it, but who may bring varying levels of expertise to the comprehension of content. The subtleties in writing for such a diverse readership may escape the second language writer, already struggling to keep a single audience focus under control. The concern for the reader's purpose and the reader's level of commitment to the end use of the information are rhetorical concerns, since the choice of vocabulary, formality of register, and presentation are adjusted in the creation of text. How these decisions are made psychologically (and what this has meant in explaining the writing process) will first be discussed briefly below.

1.4.4 The Cognitive Process Model of How Writers Create Text.

In the 1970s concerns were raised about the ability of high school and university graduates in the United States to write well enough to acquire "credentials for economic citizenship" (Hairston, 1990, p. 9). However, studies of first-language high school students showed that poor writers were simply beginners at writing, and as such, were learning by making mistakes. Therefore, it was not enough to look only at their written products, but also to examine "*how* that product came into being and *why* it assumed the form it

did (Hairston, 1990, p. 9, emphasis in the original). It was increasingly apparent that in order to teach correct and appropriate writing, it was necessary to look at the internal act of writing if teachers wanted to be able to affect its outcome. Furthermore, it was felt that writing could not be separated from its context, "that audience and intention should affect the stages of the creative process" (Hairston, p.11).

The term process is used in two ways, namely the cognitive composing strategies of the individual writer, and the more visible acts engaged in during the composing procedure. As a cognitive activity, writing involves

> ...the use of specific kinds of knowledge a writer has and is able to discover in constructing meanings and expressing them in writing. Underlying this and enabling this use of knowledge are a variety of cognitive processes, including: discovering or generating an intended propositional meaning; selecting aspects of an intended meaning to be expressed; choosing language forms that encode this meaning explicitly, and simultaneously, guide the writer/reader through different levels of comprehension; reviewing what has been written, and often revising to change and improve meaning and its expression. These processes reflect not only a writer's knowledge, thinking strategies and skills, but also are influenced by general limitations on a writer's processing capacities and performance. (Frederiksen & Dominic, 1981, p. 2)

According to research by Flower and Hayes (1981) on the cognitive processes of the writer/composer, writing is an act of discovery. Through their protocol analysis, in which writers are interviewed, asked to complete questionnaires, and most importantly, to talk through their thinking as they compose, Flower and Hayes found that most writers do not have a complete set of well-organized ideas before they write. Instead, they develop their writing intuitively, discovering both new ideas and re-organizing as

they write. More recent researchers (e.g., Winsor, 1990, 1996a, 1996b), have also explored the internal decision-making processes of young engineers as they learn to write. However, her studies are more socially based and focus on how that cognitive process evolves in response to the exigences of both the university and the workplace.

Unlike the linear progression in writing described in structuralist and rhetorical models, Flower and Hayes (1981; reported in Hairston, 1990) found that the writing process is "messy, recursive, convoluted, and uneven. Using talk-aloud or protocol analyses they discovered that writers write, plan, revise, anticipate, and review throughout the writing process, moving back and forth among the different operations involved in writing without any apparent plan" (reported in Hairston, 1990, p. 12; and in Flower & Hayes, 1981). For Flower and Hayes, the cognitive process theory rests on four key points. In addition to describing the process of writing as a distinctive set of non-linear thinking processes orchestrated by the writer, they state these processes have a hierarchical, highly embedded organization. Furthermore, the act of composing is a goal-directed process, directed by a writer's own growing network of goals which are, in turn, created in two key ways, namely

> ...by generating both high-level goals and supporting sub-goals which embody the writer's developing sense of purpose, and then, at times, by changing major goals or even establishing entirely new ones based on what has been learned in the act of writing. (Flower & Hayes, 1981, p. 366)

There are three main units in the process model: the task environment, the writer's long-term memory, and the writing process. The components in the model include the following: the rhetorical problem, the written text, long-term memory, planning, goal-setting, translating/transcribing, reviewing, and monitoring. These components are not, of course, excluded from other

approaches to writing. In the cognitive process approach, however, the emphasis in each is more psychological than social or structural.

The cognitive process studies have illuminated

> ...the profound differences between the writing behaviors of skilled and unskilled writers and the behaviors of students and professional writers. Those differences involve the amount of time spent on writing, the amount of time preparing to write, the number of drafts written, the concern for audience, the number of changes and the stages at which they are made, the frequency and the length of pauses during writing, the way in which those pauses are used, the amount of time spent rereading and reformulating, and the kind and number of constraints that the writers are aware of as they work. (Hairston, pp. 12-13)

Experts and novices solve the problems posed by the task of writing differently; for example, experts write reader-based prose, while novices produce writer-based prose concerned more with text. And while experts make global revisions, novices mostly revise on a word level. In addition, novices may follow an orderly procedure but lose their train of thought because of the energy required to attend to mechanical concerns. It may even be that basic writers have a different grammar of written language, an intermediate form between speech and writing. (This raises the intriguing suggestion that there may be a kind of recognizable interlanguage in the development of writing competence either similar to, or a variant of, the general interlanguage system hypothesized for the language acquisition process as a whole, similar to the style shifting suggested by Kutz, (1998).) Finally, inexperienced writers tend to follow rigid rules and have inflexible plans (Freedman, Dyson, Flower, & Chafe, 1987).

The mental pressures on those struggling to write in a second language can also be identified with these components and processes. For example, drawing information out of long-term

memory might be more challenging for ESL writers if linguistic forms and perhaps content are insufficiently mastered. ESL writers may need to devote more of their memory capacity to finding the right words and structures, leaving less mental capacity to deal with global planning. In one study (Berman, 1994), students had a reduced capacity to transfer newly learned essay writing skills into their L2 (English, a language in which they were not grammatically proficient). In contrast, they had less difficulty in transferring these essay skills into Icelandic, their native language, in which all students were grammatically proficient. The ability to process appropriate writing strategies is at least partially related to overall grammatical proficiency. This suggests that a basis in writing skills in the native language is an important foundation for non-native writers of English and that "some sort of threshold or language competence ceiling has to be attained before existing abilities in the first language can begin to transfer" (Berman, p. 29).

In addition, for immature and inexperienced writers (including ESL writers), the act of translating, of "putting ideas into visible language, on a continuum from generic and formal demands through syntactic and lexical ones [may be] an extra burden [which] may overwhelm the limited capacity of the short-term memory" (Flower & Hayes, 1981, p. 374). Finally, in terms of the monitoring capacity which determines when a writer moves from one internal process to the next, "immature writers lack an 'executive routine' which would promote switching between processes or encourage the sustained generation of ideas" (Ibid, p. 374).

Flower and Hayes (1981) consider rather extensively the goal-setting nature of the writer's cognitive processes: "The act of defining one's own rhetorical problem and setting goals is an important part of 'being creative' and can account for some important differences between good and poor writers" (p. 373). Rather than pre-set plans, they have discovered that writers develop a network of goals and sub-goals which is created in tandem with

discovery and an understanding of the 'logic' or genre requirements of the writing task (whether list or essay). They found that

> ...poor writers will frequently depend on very abstract, undeveloped top-level goals...even though such goals are much harder to work with than a more operational goal...[...]...Alternatively, poor writers will depend on only very low-level goals, such as finishing a sentence or correctly spelling a word....Therefore, one might predict that an important difference between good and poor writers will be in both the quantity and quality of the middle range of goals they create. (Flower & Hayes, 1981, pp. 376-379)

Whalen's (1988) study on the nature of difficulties of writing in a second language focuses on the complexity of the second language writing task and the interaction between the written product and the underlying mental processes. Using protocol analyses similar to the ones initiated by Flower and Hayes, she noted an exaggerated preoccupation with the process of goal-setting and with the organization of the subject's planning. The need to operate at many cognitive processing levels simultaneously means that many second language writers may not master the complex processes and interactions involved in relating form and content in a second language.

The Flower and Hayes (1981) model of writing as a cognitive process is based on Herbert Simon's theories of human problem-solving which includes feedback loops within simple information processing systems (Faigley, 1990). Their work and others' have highlighted the fact that the current-traditional rhetorical model only prescribes the steps to achieve adequate written product; it does not consider what actually happens in the writer's mind. In fact, many researchers working within the cognitive process approach have discovered, for instance, that many students and professional writers do not follow outlines but write first to discover a controlling idea, and that the goals or plans they create do not usually resemble the traditional outline. It may be that the

difference between good and poor writers lies more in their processing strategies than in how they follow prescribed logical plans (Beach & Bridwell, 1984).

Flower and Hayes's process model of writing implies the dominance of one processing strategy over another as conceptual focuses are shifted for whole blocks of text. De Beaugrande (1982), on the other hand, believes that writing is more accurately represented by a parallel-stage interaction model, multi-level in design, where content and form interact simultaneously at all levels to constitute both the focus and the reason for ongoing communication. De Beaugrande has criticized both structuralist and mentalist views on writing and offers instead what he calls a science of composition that investigates writing processes. His research program includes:

(a) a model of the operations and controls involved in writing;
(b) an account of how writing conditions differ systematically from speaking conditions;
(c) an explication of strategies of decision and selection;
(d) a means for decomposing the entire writing process into manageably small subtasks;
(e) a prediction of the most preponderant difficulties in writing, that is, of the normal weak points in the production system; and
(f) a set of criteria for evaluating and revising written text. (p. 232)

De Beaugrande's cognitive approach explicitly encompasses several other components; in particular, de Beaugrande nestles the act of writing within its essential social context. Other important considerations included in his model are communicative skills in general; skills such as learning, planning, interaction, and problem solving; theories of reading and reader-writer interactions; and the distinctiveness of writing compared to speaking: Poor student writers "experience a processing overload when trying to write under the habits of speaking, but they can compensate through

explicit revision techniques, addressing just one factor at a time" (p. 240). And later, he states that

> [f]or the basic writer, success depends crucially on being able to factor out one's own problems until they become obvious and tractable, according to the techniques of solving problems by decomposing them into sub-problems....The leap from speech habits to writing habits is not usually navigable any other way" (de Beaugrande, p. 248).

Britton (discussed in Faigley, 1990, and in Freedman, 1983) studied the developing sense of audience among young writers. Without the 'reactive' audience immediately available, as in conversation, children find it difficult to create a sense of a reader who is not there; instead, they imagine a generalized context for their writing and only later fine-tune their specific sense of reader. Other cognitive researchers have adapted the developmental stage theories of Piaget and applied them to young writers. They hold that children's lack of a sense of audience which is based on the inability to decenter, to imagine another perspective, develops in writing more slowly than in speaking (Faigley, 1990). Criticism of un-directed and egocentric text produced by second language writers also suggests that there is a maturational component to learning to write in a second language. Unlike children, however, the constraints on the production of reader-directed text by adult second language writers are likely to be more linguistic and social than developmental (Faigley, 1990).

The sense of audience in relation to text may be difficult for second language writers to create without the understanding generated by appropriate cultural and/or professional experience. Some of this understanding comes from extensive related reading, an activity second language learners in general, and engineering students in particular, do not usually take the opportunity to engage in (Brown, 1988). Personal experience and anecdotes from engineers and colleagues support this impression of the limited reading

experience of many second language engineering students which may relate to difficulties in writing.

> In studying the writer's acquisition of text-structure schemata or self-assessing inferences, researchers recognize that these skills accrue from reading. The ability to summarize information while reading, for example, carries over to the ability to discern the gist or goal of one's own writing. (Beach & Bridwell, 1984, p. 5)

Studies of second language readers (e.g., Jenkin, Jordan & Weiland, 1993) suggest that information read in a second language is represented differently from the same information read in a first language: "While mental models seem better suited to gist recall (or the extraction of meaning), propositional representations seem better suited to specific recognition of surface features" (p. 136). If this is true for reading comprehension, it may also be the case that when second language writers compose and then analyze their own writing through reading they employ different processing techniques that vary depending on their level of language proficiency.

The cognitive process approach to writing is important because earlier views of writing competence were either product-focused or external or sequential in orientation; they did not allow for psychological factors in the composing process. The cognitive process approach provides an additional dimension by looking at the writer's psychological strategies in response to the demands of writing. Most importantly, it presents the act of writing as a messy, recursive activity where internally and externally-oriented goals interact with social, linguistic and communicative constraints. Underlying writing as a cognitive activity are a variety of processes including discovery, selection, encoding, and reviewing. The writing process also depends on what writers know about language forms and principles, how they imagine the communicative functions of their written messages, and how they perceive the context or situations of their writing (Frederiksen & Dominic, 1981). In short,

in the process approach the writer as thinker/processor became as central a focus as text, content and style.

Critics of the recursive, cognitive process model of writing have criticized its focusing primarily on internal processes. Instead, they call for a more complete view, one that incorporates both mental and social variables. As Giroux (discussed in Faigley, 1990, p. 45) has pointed out: "[W]riting, like other acts of literacy, is not universal but social in nature and cannot be removed from culture". The cognitive view "collapses cultural issues under the label 'audience', reducing it to the status of a variable in an equation" (p. 45). It thus neglects the role of content in writing and the potential social conflicts inherent in acts of writing: "As a consequence, pedagogies assuming a cognitive view tend to overlook differences in language use among students of different social classes, genders and ethnic backgrounds" (Faigley, p. 45). The relevance of this criticism to the case of second language writers will be discussed with reference to the social view of writing below.

1.4.5 The Social Views of Writing.

According to Spolsky (1989), a model of the acquisition of a language skill such as writing must include more than a Chomskyan view of single underlying linguistic competence. It must also include procedural knowledge and thus becomes a performance or processing model as well, one that underpins both the cognitive view of language and a theory of communicative competence. Since these processes are geared towards contextualized, purposive activity, the language knowledge a writer accesses must include not just structural but pragmatic and functional aspects. The communicative functions of text incorporate an awareness of roles, scripts, formulas, and status, among other sociolinguistic aspects. In this view, a growing sense of the context around the act of writing has re-focused attention: the understanding of the self can only be social and culture-specific, not neutral or abstract. It is this view

that is evident in the new approaches to genre. It is based on a theory of the social construction of knowledge and dominates the current socially-oriented thinking about writing.

To respond to concerns about product or process orientations, this social construction perspective incorporates both product and process. In a desire to re-center the writer and text within a context, it has looked for insights from other relevant areas of inquiry, in particular the work in literacy, ethnography, systemic-functional grammar, and genre and register analysis. The social view of writing, which started in the mid-1980s (Miller, 1984, 1994) parallels the ethnographically based movement towards communicative language learning (Hymes, 1974, 1979). It is somewhat less codified and less constituted than the older rhetorical or cognitive views because it borrows from several disciplinary traditions. However, most researchers would agree that "human language, including writing, can be understood only from the perspective of a society rather than a single individual" (Faigley, 1990, p. 45). Faigley stresses that the focus of a social view of writing "is not on how the social situation influences the individual, but on how the individual is a constituent of a culture" (Ibid., p. 46). Writing develops in response to exigences of context.

Both literacy research and ethnography have focused on the social consequences of writing. Current literacy studies, for example, are strongly oriented towards the social centredness of writing. As Gumperz and Cook-Gumperz (1992), Gumperz (1986) and Cook-Gumperz (1986) point out, modern bureaucratic industrial society is culturally and ethnically very diverse. The potential for social conflict arising out of miscommunication will continue to exist unless the notion of literacy includes more than textual focuses:

> We expect literacy to provide not just a technical skill but also a set of prescriptions about using knowledge. Literacy is not just the simple ability to read and write. By possessing and performing these skills we exercise socially approved and

> approvable talents; in other words, literacy is a socially constructed phenomenon. (Cook-Gumperz, 1986, p. 1)

In her book, Academic Literacy and the Nature of Expertise, Geisler (1994) sets out the very real cognitive and social constraints of movement into professional literacy and highlights the reliance on "cultural capital" (p. 97), typically white, Anglo-Protestant in Geisler's context, that eases the transition for some novices.

> Ultimately, the two analytic perspectives on expert-novice differences, one cognitive, the other social, cannot be easily untangled. People acquire the knowledge and attitudes necessary to be members of the general public--sociological indoctrination--at the same time that they acquire knowledge and skills--a cognitive development. (p.209)

As Horning (1993) reaffirms, in reference to the nonwhite, female or immigrant workforce that will predominate in the U.S. work force by the year 2000: "[U]nderstanding expository written texts is fundamental to the success of the 'underprepared' and everyone else entering the changing work force" (p. xiv).

Much of the social view of literacy is based on a pragmatic and ethnographic view of the development of language competence and language use, in particular the ethnography of communication set forth earlier by Hymes (1974, 1979). Hymes had rejected the abstract Chomskyan view of competence in favour of a more performance (or use)-oriented perspective. He stated we need

> ...a theory that can deal with a heterogeneous speech community, differential competence, the constitutive role of sociocultural features that can take into account such phenomena as socio-economic differences, multilingual mastery, L-1 limitations, expressive values, socially determined perception, conceptual styles, and shared norms for the evaluation of variables. (Hymes, 1974, p. 13)

As he later summarized:

> [T]he goal of a broad theory of competence can be said to be to show the ways in which the systemically possible, the feasible, and the appropriate are linked to produce and interpret actually occurring cultural behavior. (Hymes, 1979, pp. 23-24)

Hymes presents the concept of a speech community whose members share its organized ways of speaking, together with the conditions and meanings of their use: "..[W]ays of speaking are to be characterized in terms of a relationship between styles, on the one hand, and contexts of discourse on the other " (Hymes, 1974, p. 18). Unlike Chomsky's notion of universal competence, Hymes' view of speech communities includes an unequal distribution of abilities and opportunities for their use. The roles people assume, the scripts and routines they follow, and the formulaic expressions they favour, both in conversation and in writing, are dynamic, not static. They respond to the exigences of context and common practice, not simply to individual choice.

As Gumperz and Cook-Gumperz (1992) point out:

> Although the pragmatic conditions of communicative tasks are theoretically taken to be universal, the realizations of these tasks as social practices are culturally variable...[involving] (1) different cultural assumptions about the situation,...(2) different ways of structuring information...[and] (3)...the use of a different set of unconscious linguistic conventions" (pp. 12-13).

Within their ethnographic framework, the emphasis is skewed towards a political forum: the ways of organizing ideas and of making lexico-grammatical selection reflect cultural assumptions and may entail social or power considerations.

The idea of a speech community can be likened to the new rhetoric's discourse community: both involve the normalized

responses to recurring practices and membership expectations. In each, the structural, semantic, pragmatic, and functional aspects of language are interrelated in complex rules of use. Each type of community is accessible through learning as well as through osmosis, and each may be more visible to newcomers than to long-time participants (Doheny-Farina, 1992, p. 296). This sense of membership relates both to the idea of speech community, as presented by Hymes, and to the idea of a self-affirming group which takes upon itself the tasks and responsibility of interpreting texts in specific, locally recognized, ways. It is the social (and/or professional) determination of the group, as manifested through acceptable rhetorical practices, that establishes both a producer and audience for writing.

For Swales (1990), a discourse community shares common public goals, has mechanisms for intercommunication among its members, uses participatory feedback mechanisms, possesses one or more genres to further its aims, has acquired specific lexis, and has a "threshold level of members with a suitable degree of relevant content and discoursal expertise" (pp. 24-31). But discourse community membership may not be fixed and an individual may be a member of several different discourse groups at the same time throughout his or her educational and professional development. The recognition of any particular disciplinary group's way of producing meaning can create tensions within an individual that must be balanced. Learning how and why texts are created is part of the membership and balancing process, especially in more explicitly defined groups, such as professional disciplines. The professional discourse community has an identity which is sanctioned and maintained through writing that is seen to be socially constructed and represented within its various contexts by fluid yet recognizable text types, or temporarily stable genres. Part of the discourse community's identity arises from the way genres are shaped, as well as how register is defined for a particular writing community. A genre is typically seen as a text type (e.g., list, essay, play, report). Ferguson (1994) defines genre as:

> ...a message type that recurs regularly in a community (*in terms of semantic content, participants, occasions of use, and so on*) will tend over time to develop an identifying internal structure, differentiated from other message types in the repertoire of the community. (p. 21, emphasis in the original)

But Swales (1990) emphasizes genre's more social role, and defines it as comprising

> ...a class of communicative events, the members of which share some set of communicative purposes [which are] recognized by experts of the parent discourse community and thereby constitute the rationale for the genre. This rationale shapes the schematic structure of the discourse and influences and constrains choice of content and style. Communicative purpose is both a privileged criterion and one that operates to keep the scope of a genre...narrowly focused on comparable rhetorical action. In addition to purpose, examplars of a genre exhibit various patterns of similarity in terms of structure, style, content and intended audience. If all high probability expectations are realized, the exemplar will be viewed as prototypical by the parent discourse community. The genre names inherited and produced by discourse communities and imported by others constitute valuable ethnographic communication, but typically need further validation. (p. 58)

The ways of speaking or writing relevant to speech or discourse communities and the genres they contain are also manifested through their register. While genre tends to include broader social and cultural boundaries on writing, register deals with text-level questions, based more on lexical and syntactic selection. Ferguson (1994) defines register rather broadly as "a communication situation that recurs regularly in a society (*in terms of participants, setting, communicative functions, and so forth*) [which] will tend over time to develop identifying markers of language structure and language use different from the language of other communication situations" (p. 20, emphasis in the original).

Different written registers may show unique features of lexicon, lexical collocation, sentence structures, and intersentential linking devices (Ferguson, 1994, p. 21).

In Halliday's (1978) model of the social view of language, in order to understand the exchange of meaning it is necessary to consider questions about text and code in social and functional terms. This also involves the consideration of register to account for the changes language undergoes each time it is put to different uses. The language variation stems from the use to which it is put as opposed to dialectical variation that originates in the user.

The principal controlling variables out of which register is constructed are field of discourse (type of social action and situations), tenor (role relationships of addressee and addressor), and mode (the organization of text), as well as choice between spoken and written discourses and the finer sets of choices within each of these. The activities in which people are engaged and in which language plays a part influence the linguistic selections that together make up discourse.

Sometimes highly specialized fields of discourse may seem to be out of common reach:

> Many specialist roles in our society so restrict the language used to realize them verbally that they become fully comprehensible only to those acquainted with that specialization and its characteristic verbalized actions. In English, contrary to some popular opinion, this restricted nature of Technical English does not exclude them from being a part of Standard English; the criterion of 'high range of intelligibility' can be qualified as 'high range of intelligibility *among users acquainted with the field of discourse*'. (Gregory & Carroll, p. 31; emphasis in the original)

In reference to the specialized kinds of registers found in occupational settings, Widdowson (1983) sees register primarily as

being a characterization of texts in respect of their formal linguistic properties: "...[R]egisters...differ primarily in form" (p. 28), yet he also reiterates the basic functional (social) aspects of a register used for specific purposes such as engineering: "If analysis isolates elements from its operational complex as whole, then it must deny them the functional features which alone can give them their component status" (p. 84).

Competence in different registers depends on more than learning linguistic elements of text production. It requires a kind of literacy that includes particular practices in particular situations. Ethnographic perspectives on writing have promoted the importance of cultural and social considerations in the acquisition of communication skills (Hymes, 1972, 1974). Literacy research has further shown how the skill of writing has social and political consequences (Cook-Gumperz, 1986; Geisler, 1994). Herndl (1993) would argue for a political perspective as well:

> Once we abandon the current-traditional rhetoric's notion of writing as a neutral, apolitical skill, we must recognize that discourse is inseparable from institutions, from organizational structures, from disciplinary and professional knowledge claims and interest, and from the day-to-day interaction of workers. Because discourse is related recursively to social practice and institutions--each shaping the other--we have to face the fact that in teaching discourse we are unavoidably engaged in the production of professional and cultural power. (Herndl, 1993, pp. 353-354)

Herndl emphasizes the fact that the pressures towards conformity within a professional discourse community are strong but often tacit and so not always discernible, especially to second language entrants. A discourse community can also change as the interactions of its participants dictate adjustments in the genres they use to maintain common understanding: "[A] discourse community is not static; if it is perceived to be static, then it only

serves to maintain status quo and serves gatekeeping functions (Pratt, 1998, p. 180)

While researchers (especially rhetoricians and those working in genre studies) have focused on identifying distinct professional and non-academic discourses in terms of underlying similarities, there are still differences and conflicts within professional discourses which novices must adapt to:

> The consequence is that the discourse we refer to when we talk about the 'discourse of engineering,' etc. is all too often a reification of the dominant position which flattens the discursive and ideological struggles that exist within any social or institutional practice....If we describe these struggles and their different interests and consequences, we can open a space for students to recognize the range of positions negotiated by and sometimes excluded from the dominant discourse. (Herndl, 1993, pp. 354-355)

As Harris (1990) asserts:

> We write not as isolated individuals but as members of communities whose beliefs, concerns, and practices both instigate and constrain, at least in part, the sorts of things we can say. Our aims and intentions in writing are thus not merely personal, idiosyncratic, but reflective of the communities to which we belong. (p. 268)

Faigley (1990), however, cautions against generalizing about discourse communities:

> From a social perspective, a major shortcoming in studies that contrast expert and novice writers lies...in the assumption that expertise can be defined outside of a specific community of writers. Since individual expertise varies across communities, there can be no one definition of an expert writer. (Faigley, 1990, p. 47)

More similar to Faigley than to Swales, Harris also rejects what he calls the "sweeping and vague" notions of community and calls for explicit analysis of the operating rules of boundaries of specific communities (p. 268). In particular, Harris discusses how pitting common against specialized discourses can entail the positioning of privilege, of insiders and outsiders. Furthermore, he asserts that stepping across the boundaries of discourse communities is neither easy nor clean, requiring a repositioning of "the self in relation to several and continuous and conflicting discourses; students are confronted with ways of talking about the world with which they are not wholly familiar" (pp. 272-273). It may be that students or novice writers in a field fear losing a personal identity as they take on a public one, especially one in a second language. Certain forces are communal rather than social, involving power but not consent (Edelsky, 1986).

Geisler (1994) considers the role the academy plays in maintaining literacy standards in such a way that makes it difficult for newcomers to enter. She argues that schools promote an arhetorical, or decontextualized, view of text in the way that they teach and that this view protects the interests of professionals who stake out their own exclusive claim to expertise. The forces that come into play during the transitional years of academic preparation for a profession are reflections of how ensconced members promote the standards for competence in the field, including the norms for writing and other ways of communicating.

A social view of writing takes the concept of audience, for example, away from aiming for an amorphous, cognitive goal or a neutral procedural/stylistic stage, and moves it into a specific context, with an identifiable readership, a localized purpose, and an explicit shape. This sense of audience is dynamic and variable but can also be restrictive (Bazerman, 1994). Acceptance of, and adherence to, recurrent writing practices validates membership and recognized experts reiterate these standards through their feedback

to novices. Berkenkotter, Huckin and Ackerman (1991), for example, describe how

> [g]raduate students are initiated into the research community through the reading and writing they do, through instruction in research methodology, and through interaction with faculty and with their peers. A major part of this initiation process is learning how to use appropriate written linguistic conventions for communicating through disciplinary forums. (p. 193)

Issues of educational experience, power relationships, familiarity with specific rhetorical patterns, and ways of thinking about knowledge claims are all salient in the description of novices struggling to enter the writing community of their profession (Geisler, 1994; Herndl, 1996). Novice writers may be able to assimilate only by also developing an understanding of the social roles members of the organization play and the corporate voice they themselves must emulate, even as they deal with their initial lack of authority (Duin & Hansen, 1996). For some second language writers, acquiescing to cultural and professional norms may also involve decisions about adopting new and contrasting values when entering a majority academic or workplace situation which is racially or ethnically different (Hamp-Lyons, 1991). The personal conflict between selling out versus integrating for success arises from a students' ethnic and cultural background and current socio-political status, and its resolution is only partly linguistic. In order to be able to write <u>as</u> an insider it is important to have a sense of belonging, to feel one <u>is</u> an insider.

As Hamp-Lyons (1991), speaking of the American situation, points out:

> Entering a new community is always stressful, leading to self-questioning and possible loss of identity. We hear more and more of the extreme difficulty for minority students of the transition to the academic culture, and the poor retention for minority students by most colleges other than the historically

> Black colleges. We might assume then, that the transition would be at least as difficult for the ESL learner (p. 56).

It also brings to mind Krashen, Dulay and Burt's concept of an affective filter (cf. Krashen, 1981), the first hurdle to accepting a second language. A learner's openness to language is related to personal motives, needs, attitudes, and emotional states. In relation to writing competence, the affective filter may determine which target models the learner will select, which parts of the language will be attended to first, when language acquisition efforts should cease, and how fast a learner will acquire the language. Thus, "all the differences of ESL writers: language, ethnicity, religious and political affiliation, socioeconomic status, exposure to English language writing and 'western' or Anglo cultures...are brought with ESL into the academic or workplace situation" (Hamp-Lyons, 1991, pp. 60-61).

In her analysis of readable writing, Horning (1993) has introduced the notion of individual differences along with the social and political. If knowledge and written representations of knowledge within a field are socially constructed, then the individual's role within that society cannot be peripheral, as it tends to be in a purely rhetorical framework or even within a cognitive model, where mind rather than person is emphasized. Horning claims aspects of personality types (such as introversion and extroversion) influence the ease of acquisition of both reading and writing competence (p. 33-34). Horning's views on the psycholinguistics of readable writing become particularly relevant to the case of second language writers when the issue of evaluation is raised. She discusses the ways in which various types of reader/raters may respond to text: holistic, sensing, thinking or analytical, intuitive, and perceiving.

Second language writers face a number of evaluation hurdles in the course of their academic and professional careers and various aspects of how they handle the demands of writing in a second language may be held up to critical scrutiny. In addition to manifesting individual personality factors and psychological

constraints on their processing strategies, second language writers will be judged according to their texts' structural and lexical correctness and appropriacy, use of specific discourse features, and culturally and professionally appropriate rhetorical organization. In addition, they now, it seems, also risk being judged by someone whose personality type as a reader/rater differs radically from their own.

There may be concepts about textual logic that cross cultural barriers. Horning's (1993) research, for example, demonstrates that "while various cultural and individual constraints influence its shape, the two essential psycholinguistic features of cohesion and redundancy cross all cultural and individual boundaries in a way that permits a deep understanding and appreciation of readable writing" (p. 2). Horning's definitions of cohesion, coherence and redundancy are based firmly in a Hallidayan framework, where context of situation has a central role. In Horning's propositional/schema theory, knowledge or meaning is encoded in memory as a series of propositions. The schema theory helps explain how text and reader interact. Prior knowledge can take advantage of and/or create redundancy in a text, including an individual's preference for certain kinds of text. Horning adds the Jungian view that "personality preferences interlock with propositional/schema theory and with the concept of redundancy...and play a role in the response of readers to passages....[M]oreover, a person's preferences are apparently unrelated to culture or ethnicity" (p. 31).

How then does a second language student learn to write like an expert? To a certain degree, education promotes uniformity; the longer an ESL student studies his or her profession in English, the more likely he or she is going to conform to the writing requirements of the field. However, it is not clear (and some research studies have suggested otherwise: cf. Currie, 1993; or Freedman & Medway, 1994a) that academic preparation for a profession, whether of first or second language students, necessarily includes an explicit clarification of the field's discourse

features. Geisler (1994), indeed, would argue that academic preparation is not only unhelpful but serves the purpose of artificially maintaining a great divide, a separation between academic and professional rhetorical requirements: "...[S]chooling provides all students with a naive understanding of the more formal component of expertise but withholds an understanding of a tacit rhetorical dimension" (p. 82).

The social view of writing, of learning to be an accredited member of a particular writing community, presents the notion that understanding the role of writing requires one to be in the role of a member-writer. In this perspective, novices to a discourse community only truly understand the communicative power of writing when they are situated within the socio-political process of creating text for real audiences, authentic requirements and naturalistic constraints of the environment of doing. It is only when knowledge is not simply shared but constructed between and among communication participants that typical texts (genres) become recognized as appropriate forms of action that create effective communication (Dias, Freedman, Medway, & Paré, 1999).

1.4.6 Genre Perspectives Within the Social View of Writing

The social view of writing has generated a re-conceptualization of the role of discourse and of genre. To a large degree, mastery of the conventions of use determines the degree of acculturation to a field's writing requirements. In a social view of writing, mastery comes with actual practice in context; in an academic transitional phase, the rudiments of acculturation are activated. Acculturation, in the context of this research, means the understanding and production of a specific kind of written genre which will satisfy professionals in the field. This involves making appropriate decisions about how to understand and construct the required discourse to support that genre.

Looking first at the term discourse itself, Nunan (1993) points out that there are many definitions offered by different researchers. One difficulty is the confusion between the terms text and discourse which echoes the dichotomy between formal and functional aspects of language. Text can be viewed as simply a cohesive verbal record of a communicative event, language which often "consists of more than one sentence and the sentences combine to form a meaningful whole" (Nunan, 1993, p. 6). Or, in Gregory and Carroll's (1978) terms, text is "...both a physical thing and a semantic unit; and it is what happens in language in action" (p.3). Discourse is also generally seen as a piece of meaningful, naturally occurring language which serves some purpose within an identifiable context and which can be understood through discourse analysis. Nunan asserts that discourse analysis involves "the study of language in use...compared with an analysis of the structural properties of language divorced from their communicative functions,....[t]he aim [being] to show and interpret the relationship between these regularities and the meanings and purposes expressed through discourse" (p. 6). Brown and Yule (1983) also claim that doing discourse analysis involves semantics and syntax but mostly pragmatics.

Kress (1985), on the other hand, has a wider view of discourse and a richer vision of text. For him, a discourse organizes and gives structure to the manner in which a topic, object or process is to be talked about. Different discourses exist within a culture and may offer opposing views of a particular context. Eventually, one discourse becomes not only unchallenged, but unchallengeable, as "common sense" (pp. 4-10) One example is technical discourse within the field of engineering, which is reified in writing as so-called common practice.

Texts, for Kress, are 1) the manifestations of discourses, 2) the meanings of discourses, and 3) the sites of attempts to resolve problems (pp. 10-12). Text, discourse and genre are intimately connected because of the centrality of the individual as social agent.

"The function of the writer is to construct texts which confirm or alter the manner in which particular texts are read" (p. 18).

Studies on how text is generated to serve specific academic or professional purposes have focused on role relationships, functions of text within organizations, and presuppositions and constraints about content organization and linguistic form. Swales (1990), for example, incorporates both discourse level and genre-specific analyses in his discussion of how academic and professional writing can be interpreted as serving communicative purposes within discourse communities. He also highlights much of the research on schema theory which explains to a large degree how writers and readers create text on the basis of their prior knowledge of how content and text should be framed within a particular community. Paltridge (1997) also considers schema theory and the notions of prototypicality of text types in our understanding of genre. He expands the concept of generic frames, however, by discussing how the semantic memory of a type of text, along with the intertextuality within and between texts, shapes our response to requirements for the creation of a specific genre. In the case of second language writers, socio-contextual clues and notions of text types would be less available for guidance since prior experience ("knowledge of previously encountered texts" (Paltridge, 1997, p. 57), might well be limited for reasons of cultural or experiential, rather than purely linguistic, differences.

Genre studies have revealed the communication acts or products of technical or professional fields; they have also focused on the approximation of learners to the level of acceptable linguistic and professional performance required by those fields. Like discourse analysis, early genre analysis clarified the particular logical relationships and their expression through such specific features as discourse markers, reference, substitution, ellipsis, lexico-grammatical selection, tone, focus, and so on (Bhatia, 1995; Freedman, 1987; Gumperz & Hymes, 1972; Halliday, 1979; Sinclair et al., 1993). Recent perspectives see genre as socially constructed

products which respond to workplace requirements for the creation, exchange and assessment of knowledge. This social response aspect of genres is evident in the research by Swales (1990) who presents the view that texts are socially constructed (functionally interlinked), increasingly typified and labeled (i.e., specified as to genre), and are locally evaluated (judged in terms of the expectations, norms and agendas of their target discourse communities). Genres, in turn,

> ...comprise a class of communicative events, the members of which share some set of communicative purposes. These purposes are recognized by the expert members of the parent discourse community, and thereby constitute the rationale for the genre. This rationale shapes the schematic structure of the discourse and influences and constrains choice of content and style (Swales, 1990, p. 58).

Swales provides a thorough discussion of some key aspects of English for Specific Purposes by focusing on genre analysis and its relation to the understanding and pedagogy of specific language use. By grounding genre analysis in the concept of discourse community and then extending these ideas to practical implementation, he makes it possible for a teacher to appreciate how genre analysis can steer pedagogy. As Carolyn Miller has summarized:

> As a recurrent, significant action, a genre embodies an aspect of cultural rationality. For the critic, genres can serve both as an index to cultural patterns and as tools for exploring the achievements of particular speakers and writers; for the student, genres serve as keys to understanding how to participate in the actions of a community. (Miller, 1984, p. 163)

Genre analysis (as presented, for example, in Bhatia, 1993; Bazerman, 1994; Berkenkotter & Huckin, 1995; Dias et al., 2000; Freedman & Medway, 1994a & 1994b; Swales, 1992) focuses on situations of use and attempts to link specific text features to the

overall acceptability of a piece of written work within context-specific constraints. It emphasizes the social construction of writing and the roles that participants and situations play in the writing endeavour. Most genre work has therefore been thickly descriptive, rather than prescriptive, with attempts made to draw rich portraits of the creation and re-creation of written work. As Freedman and Medway (1994a) summarize: "In all this research, there has been an unpacking of the complex social, cultural, institutional and/or disciplinary factors at play in the production of specific kinds of writing" and how discourse communities "use mastery of writing to enroll and initiate new members, as well as to exclude others" (p. 8).

An exploration of the factors that may set up barriers for second language students as they attempt through writing to join the engineering community must therefore move well beyond linguistic factors alone.

1.5 Learning to Write English for Specific Purposes in a Second Language Context

The examination of the writing of ESL engineering students within the field of second language acquisition is set within the area of English for Specific Purposes (ESP). A more specific sub-focus is English for Science and Technology (EST)[5]. Research over the past twenty years into the nature of specific purpose language training has highlighted the need for an increased understanding of minimum acceptance levels of performance by interest-focused second language learners. Similar to the research undertaken for first language writing development, early studies and pedagogy on specific purpose language (ESL/ESP) programs have focused on the technical language particular to the field in question, and have looked into the rhetorical patterns and underlying principles of the organization of technical writing aimed at a variety of audiences

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[5] This term includes ESL writers who may or may not be in a formal English language course.

and purposes. In addition, some studies on individual differences in the process of acquiring special purpose language have been conducted (Bhatia, 1995; Selinker, Tarone & Hanzeli, 1981; Selinker, Trimble & Trimble, 1976; Strevens, 1971, 1988; Swales, 1977; Trimble, 1985; Trimble, Trimble & Drobnic, 1978).

Insights on the writing proficiency of second language learners have gained from an extensive set of studies on the development of writing by English-first-language students. Issues related to both first and second language writing have been considered (e.g., Bazerman, 1988; Olsen & Leone, 1994; Swales, 1992; Widdowson, 1983). Work on register (e.g., Atkinson & Biber, 1994; Ferguson, 1994; Halliday, 1988) has generated descriptions of the linguistic features (lexical, grammatical, discoursal/rhetorical) that characterize certain types of text useful to ESP researchers. Sociolinguistic and cultural issues which relate to second language writers have also been raised by researchers (e.g., Collier, 1987; Fine, 1988; Herndl, 1993; Kanno, 1999; Zamel, 1998).

One interesting focus of discourse/rhetorical research has been the area of contrastive rhetoric, which attempts to explain irregularities or inappropriate writing in a second language as a reflection of culturally-determined first-language patterns. Despite their technical competence, many ESL students progress uneasily through their engineering programs. Learning to write appropriately in another language and for a specialized genre requires students to gain more than linguistic control of syntax, spelling, vocabulary, and punctuation. Although there is evidence to suggest that some genres are not solely aligned with a specific grammar but are produced cross-culturally (Ferguson, 1994), second language students are not necessarily familiar with the engineering genres represented in their first language. For many ESL students, their first contact with technical or professional writing is in their second language. For some, the transition to a specialized way of writing poses little difficulty. For many others, however, the rather formalized writing tasks required by engineering pose a special challenge.

As studies in contrastive rhetoric have suggested (Kanno, 1999; Kaplan, 1966, 1983a; Lee, 2000), different ethnic and language groups seem to conceptually organize their writing in response to culturally determined practices. "Discourse, rather than syntax or phonology...is particularly influenced by differences between cultures" (Fine, 1988, p. 2). Thus, the ways of argumentation, for example in expository prose, that would most directly provide entry to a discourse community, may be blocked by ways of thinking that are not considered appropriate in the host or target language culture, despite the learner's linguistic control of the second language. Rhetoric may not be universal either (Kaplan, 1966, p. 2) and foreign students who are what he calls "out of focus" in their written essays, theses and reports are simply "employing a rhetoric and a sequence of thought which violate the expectations of the native reader" (p. 4). Kaplan goes on to formulate, through examples, a number of specific cultural modes of thinking that are different from what he avows is English's rather linear presentation of data. ESL writers who do not follow the English pattern of rhetorical logic and formatting conventions produce a culturally-based disjunction in their text, causing confusion or irritation in their English first language readers and raising vague feelings of inadequacy about their apparently correct use of English.

For example, ESL writers (such as Arabic speakers) who come from cultures and language groups where exaggeration or overstatement is both a habit and a stylistic requirement, may find it problematic to write concise or spare technical data which English style seems to require. The apparent ambiguity or circling the point in the English text of Asian writers may stem from the Eastern view that getting directly to the point is not only stylistically improper, it is socially inappropriate. Chinese or Japanese ambiguity or diffidence in writing, for instance, is partly a reflection of the Confucian model of not insulting the audience with obvious information (Potvin & Woods, 1983; although, see Kanno, 1999, for a detailed discussion of how this interpretation has

changed)[6]. When transferred into English, this ambiguity can generate confusion in a native English reader. A cultural difference in approach is frequently manifested as disorganized, unconnected prose, and in the misuse of cohesive devices. As one Chinese graduate student commented: "The problems of organization, clarity, and conciseness are not unique to me. They are common problems among the students" (Wu, 1988, p. 182-183).

Sometimes, text by ESL writers that suffers from a poor organizational framework may present the superficial appearance of cohesion simply because the writer has included what at first seem to be the proper connecting words. Field & Oi (1992), for example, found that the Cantonese writers in their study not only used a significantly higher frequency of cohesive conjunctions in their English writing than do native English writers, but also followed different patterns in the selection and positioning of these devices. According to Field and Oi this may have been in part due to the transfer of first language problems in writing to English, as well as poor translation from the mother tongue. Discourse markers used by their students tended to appear in sentence-initial position and were seen to represent an attempt by these second language writers to hook together ideas which otherwise would have no logical connection.

The notion of formatting by topic focus, a technique so essential to technical writing, may also be a culturally determined idea (Shen, 1998). Unusual concepts of paragraphing can pose an organizational problem and subsequent reader confusion. Similarly, using an inappropriate voice may cause the reader difficulties, as can the use of language that does not convey the correct formality, distance and objectivity that the reader expects.

A common feature of poor writing is the inability to address the intended audience accurately or to engage in a reader-centered

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[6] Even the choice of media itself can be culturally determined (Lee, 2000) as can the understanding of apparently transparent graphic representations (Maitra and Goswami, 1995).

approach. Poor writers frequently produce writing that is overly egocentric in its presuppositions about topic and so does not anticipate readers' questions or needs (Couture, 1985). In ESL writing this is evident through the lack of proper introductions or conclusions, or in the inability to make smooth transitions between main ideas. As Chan and Chan (1993) discovered, students often continue to write as if the reader already knows the topic; even in assignments and reports they maintain an exam-taking approach to writing and so limit their text to straight descriptions or definitions rather than true explanations. A concern for the reader is also demonstrated in the way a text is structured physically; appropriate headings and sub-headings are important because they distinguish the main ideas from the supporting documentation and so keep a reader reading efficiently. ESL writers not only write incoherently, they also mislead the reader with inadequate or poorly titled headings. Since the writing of headings is a particularly noticeable feature of technical writing, it may not be as easy for ESL as for NES engineering writers.

One particularly relevant study on the differences between the work of NES and ESL graduate engineering students (Jenkin, Prior, Rinaldo, Wainwright-Sharp, & Bialystok, 1993) highlights how ESL writing can be judged by different standards, partly because the ESL students had no guidance as to expected rhetorical and discourse features. Undergraduate and early graduate writing tends to require description and definition as well as summary writing rather than critical analysis of other sources. However, when students were required to write theses, the Jenkin et al. study found that engineering faculty were lenient on ESL papers about sentence level features (grammar, spelling, punctuation, use) but did not make the same allowances for discourse features "where too many violations could reasonably be expected to interfere with meaning" (p. 57). Mistakes in syntax were not as problematic as content selection, organization, and valid and relevant conclusions. Faculty tended to re-write more of the ESL theses rather than simply advise about correction as they did for NES graduates. This form of support

simply perpetuated the writing weaknesses of the ESL graduates who subsequently floundered when they found that workplace writing practices were totally unlike their university experiences.

Cohesion and coherence in technical writing may depend to a large extent on the writer's awareness of cultural, academic and professional norms. Another difficulty faced by ESL writers, mentioned earlier in reference to rhetorical understanding, is how to use background information accurately without plagiarizing--a concept of integration of text into one's own writing that has recently been shown to be culturally specific and even North American, especially in its focus on the personal creativity expected of writers (Pennycook, 1998). Studies have shown that many more ESL than NES writers use "significantly more information from [a] source text than native speakers" (Campbell, 1987, p. 1), and that near copies function as foreground rather than background.

Selecting the correct rhetorical features appropriate to a field must then become an explicit choice, but only once awareness of cultural variability in writing conventions and in rhetorical differences has been raised. Otherwise, as Campbell's (1987) study indicates, second language writers will respond to unfamiliar rhetorical demands of the texts they read by seeming to be plagiarizing, although the motive for this may be more dependent on cultural practice than language inadequacy (Pennycook, 1998). Such learners are uninformed as to both the purposes of the organization of the second language text and the cultural expectations of the academic or professional discipline which requires it. They do not know what constitutes authority nor how to invoke it, so they simply rely on first language patterns of text logic and on their native culture's norms concerning data presentation and text borrowing. Imitation is expected, for example, in several Asian educational systems where it is customary to demonstrate knowledge of authority that is traditional and where correct texts are studied as models (Ballard & Clanchy, 1991). Arabic students are more likely to memorize texts as well, since oral re-telling proves

one's understanding of the knowledge based on the printed word (Carrasquillo & Rodriquez, 1996). Western students, on the other hand, are expected to provide a critique or synthesis of varying points of view, i.e., to distance themselves from sources and provide both overviews and analyses of competing positions. Faculty in English-speaking institutions thus face not only linguistic errors from their ESL students along with so-called illogical or out of focus rhetorical styles, but also a "disjunction between the attitudes to knowledge held by the student and the assumptions about appropriateness of different (culturally-shaped) attitudes to knowledge" which these faculty members hold as they evaluate students' work (Blanchard & Clanchy, 1991, p. 21). In Paltridge's (1997) terms, the conceptual basis for their genre frames would have developed very differently for writer and reader, such that the interpretation of text types and text presentation would also differ.

ESL writers may engage in the process of logical thinking differently, and may find it difficult to adjust their own culturally-defined ways of processing and presenting information when faced with English writing demands. As Kaplan (1966, 1983a) has pointed out, there are definite variations in the way text is constructed[7] and a large part of this variability is culture- and language-specific. Kaplan's earlier conclusions were that in expository writing "each language and each culture has a paragraph order unique to itself, and part of the learning of a particular language is the mastering of its logical system" (1969, p. 256).

Kaplan's (1966) view is that contrastive rhetoric should be taught, just as contrastive grammar can be taught. Kaplan was writing at a time when the current-traditional approach to rhetoric (with its study of typical rhetorical forms such as description, classification, etc.) predominated. Some studies suggest that the strength of first language rhetorical patterns and ways of thinking

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[10] More recent studies, Kanno (1999) for example, have presented softer views on the tightness of culture-bound rhetoric, as has Kaplan himself (1986). However, other researchers still report cultural constraints on communication as reflected in the selection and framing of writing in non-print media (Lee, 2000).

can resist even direct instruction in the second language (i.e., English) rhetoric, as suggested by Hinkel's (1994) study in which advanced level ESL students from Confucian-Taoist backgrounds tended to interpret second language rhetorical notions differently than did native English speakers, although both had been explicitly taught these patterns: "...[C]onceptualizations of writing appropriate to the teaching of English to NSs [native speakers] of English may not be fully accessible for pragmatic interpretation even to highly trained NNSs [non-native speakers]" (p. 374).

Despite a softening in this culture-bound view of rhetoric (Kaplan, 1986), there is current research that suggests part of this interpretation still remains valid (Carrasquillo & Rodriquez, 1996; Kanno, 1999; Lee, 2000) and that culturally learned ways of presenting logic are transferred into second language writing practices.

Culturally determined notions of rhetorical appropriacy may not be the only constraint on ESL technical writing. Reliance on past educational training can have an adverse effect as well. Engineering students who have only written fill-in-the-blanks type of lab reports in high school (and even in university science courses) or short project reports for teacher-evaluators are generally limited in their appreciation of true workplace audience demands and corporate conventions. Doheny-Farina (1992) outlines a number of studies of young engineers and other novice non-academic writers who bring their academic methods of problem-solving to workplace writing tasks where such thinking processes are neither desired nor accepted. Van de Kopple (discussed in Horning, 1993, and in Witte et al., 1992) elaborates on the given-new aspects of information shared by readers and writers; the writer's assumptions about information shared by the reader determine how the writer presents new ideas. Those who have adhered to particular styles of discourse and text features are committed to a discourse that shuts out nonexperts.

In the case of second language engineers, the discourse community of professional technical writing constitutes more than the texts available for analysis. In an ethnographic or social perspective, how these texts are generated, what they must look like (linguistically and physically), why they are important, what roles writers, texts and readers play, and what organizational constraints exist to direct the production of text must all be learned or absorbed. The rules may be overt or tacit, but the social-professional consequences of poor writing extend beyond the immediate rejection of language errors.

In sum, the difficulties some ESL writers have in producing acceptable technical writing may relate as much to culture-specific ideas of rhetorical logic and limited discourse experience as they do to linguistic inadequacies.

1.5.1 Problems of the ESL Writer: Language or Acculturation?

Students whose first language is not English constitute anywhere from one-third to over one-half of the undergraduate engineering students enrolled in Ontario universities (from the university's Office of Research and Statistics, 1995). These ratios vary across Canada and across undergraduate and graduate programs, but the numbers are significant and the special problems that they raise need to be addressed.

Canadian universities accept large numbers of non-English-speaking students (both domestic and international), primarily into business, the sciences, computer programming, and engineering. Concerns have been expressed by professors and administrators about the linguistic readiness of these students and various language proficiency testing mechanisms (e.g., TOEFL, CANTEST, CAEL)[8] are applied as either gatekeeping or scaffolding functions to

[8] TOEFL: Test of English as a Foreign Language (from the Educational Testing Services, New Jersey, U.S.A.); primarily discrete-point testing of reading, grammar, and listening comprehension. A separate writing test, the TOEFL essay, is also available.

ensure that language proficiency is at the necessary level for them to pursue academic studies (Burnaby, 1992; Elson, 1992). Many ESL students succeed in their programs on a par with native English speakers. However, many others often face a problem once they have gained admission to university. These ESL students often find that the language skills and general academic preparation that brought them into the system are not always sufficient to help them to progress successfully through their programs. Even by graduation, ESL students in technical programs may not have acquired the full writing capabilities necessary for their career.

In the case of ESL engineering students, the full impact of inadequate language and educational preparation for writing demands may not be apparent until after their second year in the program when more language-intensive or problem-solving courses are taken. The math-heavy and science-oriented course loads of first and second year do not usually provide the opportunity for engineering students to demonstrate control of clear, well-focused and accurate writing strategies. In addition, the lack of experience with different genres of writing in engineering, shared by many native English-speaking students, is not offset by the same kind of implicit cultural awareness of appropriacy that native speakers can turn to for guidance. Many ESL students who were admitted into their technical programs on the basis of their strengths in non-language skills and knowledge (e.g., in mathematics and computers) (Elson, 1992) have no back-up system to turn to when required to write because their awareness of culturally-based assumptions (in both academic and professional cultures) is limited.

Acculturation is a complex process that is not always clearly defined nor well supported for second language learners. Schein

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CANTEST: Canadian Test of English, based in the University of Ottawa (more contextualized testing, with focus on all four skills)

CAEL: Canadian Academic English Language Assessment, based in Carleton University, Ottawa (totally thematically oriented around an academic topic, covering all four skills, but emphasizing reading and writing)

(1991) includes both surface and deep aspects in his definition of culture, which he states is:

> A pattern of shared basic assumptions, invented, discovered, or developed by a given group, as it learns to cope with its problems of external adaptation and internal integration, that has worked well enough to be considered valid, and, therefore, is to be taught to new members of the group as the correct way to perceive, think, and feel in relation to those problems. (Schein, 1991, p. 249)

It cannot be assumed that NES and ESL undergraduate engineering students, as equally admitted members in their academic programs, share basic assumptions about writing. How they think about and shape writing once inside their programs, how they shape technical genres, may well be based more on cultural than linguistic experience. Nor can it be taken for granted that NES and ESL students will understand equally the professional culture of engineering and its writing requirements to which they must adapt in order to be accepted as members there. There are qualitative differences in the access requirements for these two communities, but full membership in either case is not necessarily as easily achieved for ESL novices as it is for NES novices. Appropriate acculturation to a discourse community then, means learning its genres, just as acquiring a specific pool of knowledge and particular ways of thinking is essential to gaining access to a field.

1.6 Selection of an Appropriate Research Perspective

In order to select an appropriate model, or set of models, for the understanding of this research, a brief overview of the theoretical perspectives detailed above is provided. The early behaviourist model for writing instills a sense of system in communication and identifies the vital components. However, it assumes that generic modeling would help a writer create text and presents a limited sense of a progressive development of writing. The cognitive explanations which developed in counter to the

behaviourist models highlight the inherent competence of second language writers. However, this ability is not accessed efficiently in different contexts without further strategic support. Such support is proposed through the current-traditional model of writing but again there is a prescriptive focus on product and specific linguistic devices for the linear creation of text. It offers rules concerning discourse features but is not always flexible. It also risks encouraging second language writers to depend on prefabricated routines for their writing rather than promoting flexibility in addressing the goal for writing. The current-traditional model also promotes the focuses of a dominant view of writing in its emphasis on correctness, as later countered by research in literacy and ethnography. This aspect of discoursal dominance within a particular writing community still has some relevance in the consideration of learning to write appropriately for specific disciplines such as engineering. What is referred to as the new rhetoric attempts to address some of these social aspects of writing. The orientation of a written product here includes social and ethical concerns, especially evident in its view of a wider audience, as outlined in schema theory. There is still some emphasis on effective selection procedures of discourse features and of framing propositions in terms of their effects on the reader. These aspects of diverse audience are of particular relevance to technical writing.

The cognitive process model of composing offers insights about the recursive, messy and hierarchical characteristics of writing in contrast to some of the linear ideas of composing offered by other models. The emphasis on personal creativity, however, ignores the workplace reality of writing for specific external goals. This model does offer an understanding of novice writers' composing processes in comparison to those of experts, but it is limited in its applicability to this research. The concept of an interlanguage for writing, of unique second language sequences in developing writing competence, is intriguing since it could explain some of the intervening cognitive constraints encountered by mature second

language writers as they attempt to transfer first language skills and strategies into second language writing processes. However, the current research deals only with a final written report and could only speculate about the composing processes of the student writers involved.

Although there are valuable insights from each of the theoretical perspectives outlined here, none offers a complete orientation for the current study. It is necessary, therefore, to look for a model which incorporates at least some of the more productive features of the research areas discussed so far.

The social view of writing, which developed out of the new rhetoric, appears to offer the most comprehensive framework since it draws on many of the models already described and extends their applications. Ethnographic and literacy studies situate the learner within specific contexts for writing and present a social and cultural orientation which is particularly relevant in the case of engineering. The concept of an identifiable speech community, for instance, has led to the discussion of specific discourse communities whose membership differentiates between expert and non-expert understanding and production of text. Goals for writing and audience expectations are made more explicit, but the social view is not only product-oriented. It also considers how writers progress mentally and literally through developmental stages in their writing. These aspects could be relevant to how second language writers might progress through stages in their syntactic, academic and cultural awareness of writing in English and in addressing disciplinary concerns. Studies in contrastive rhetoric have highlighted specific cultural differences in the understanding of discursive focuses which are not solely language based. The concepts of register (the importance of situation) and its manifestation through linguistic selection are particularly relevant to the development of discipline-specific writing both in academic and workplace contexts. These features of situation, audience, goals, and linguistic selection are expanded within the study of genre,

especially in the understanding of its primacy in the reification of a particular discourse community and its initiation of novice writers. It is the broader framework of the social view of writing, in short, which best informs the research on the technical writing of second language engineering students undertaken here.

The theoretical perspectives reviewed show that although various models are available for the research, the most salient ones are those that are related to aspects of contrastive rhetoric, issues of academic literacy, second language acquisition, and genre studies, with reference to the social views of writing. Recent research studies on the influence of contextual variables and situated experience in the learning of writing have focused on the development of novice writers within their prospective fields (e.g., Bazerman & Paradis, 1991; Bergmann, 2000; Berkenkotter & Huckin, 1995; Dias et al., 1999; Swales, 1990; Winsor, 1996a). These studies are therefore rich sources of field-specific descriptions of context and of the process of writing development by newcomers to a discourse community. However, the situations described there are not entirely the same as the one presented in this research. The undergraduate engineering students in this study are not in a workplace situation; rather, they are initiating both their technical and writing development. The writing task described in what follows is a simulation of a particular kind of technical report; it is not an authentic creation set within the normal exigences of workplace requirements. These students are in transition to a profession and not yet inside its writing context. The thesis research therefore attempts to clarify, in a descriptive snapshot rather than an ethnographic study, the personal and linguistic influences that may have shaped their proficiency to this point in their career development. The assumption is that many of these forces will continue to exert some level of influence even as students develop their technical and writing competencies. The study further attempts to show how the professional engineers who examine and react to the writing of these students expose their own assumptions and expectations grounded in the contexts in which they work and

write. If professional disciplines and their discourse communities are the institutions to which these students aspire then it is their level of adequacy in terms of the entrance requirements as manifested through writing that is the focus here.

Knowledge acquired from first and second language research, specifically focusing on how learners acquire appropriate writing skills, will be used in interpreting the results, as will insights gained from studies on genre, with particular reference to whether novices acquire the discourse competence required both for their current study and subsequent professional discipline. Furthermore, in order to assess the success of the transition (in terms of writing) from classroom competence to professional practice, various socio-educational realities must be taken into account.

This research focuses therefore on the level of acculturation of second language engineering students to the writing requirements of their profession, as measured by the acceptability of a technical report.

1.7 Statement of Purpose

Personal experience in teaching ESP courses and a review of relevant theoretical models and approaches to the study and teaching of technical writing suggest that an analysis of the writing of ESL engineering students must include an examination of a context that is broader than discrete linguistic features. This extended context includes academic and cultural experiences which may have shaped students' understanding of the exigences of an academic and professional writing task in all its aspects. Of special interest is Swales' (1990) discussion on "tapping into the processing strategies of experts in a specific genre" (p. 14) since it suggests both the importance of field-specific research and the possibility that there is an evolution in ways of thinking in and using language that relates to both task and experience. Task-based learning and

informed access to expert modeling could prove to be pedagogically useful.

In Miller's (1994) terms, a particular discourse community is a group of individuals who agree on and perpetuate the formal and informal communication practices of their mutual interests. The norms held by such a group may be obscure to a novice who holds quite divergent expectations of proper presentation and style. It is possible, for example, that ESL students may not readily accept formatting concepts particular to report writing because their experience of different genres has been so limited in their first language and may have been absent in their second language learning. NES writers may also face such obstacles to clarity as they attempt to apply standards of expressive writing learned in high school to the straightforward style of reports required in engineering labs. An examination of the differences between native and non-native-English-speaking writers as they attempt technical writing should clarify whether the problem originates in language proficiency or is to be found in other factors related to personal and academic backgrounds.

By drawing together an understanding of the cultural, educational and professional contexts in which ESL engineering students are operating and then by applying insights gleaned from first and second language writing research, it should be possible, first of all, to ascertain whether ESL students are in any way constrained by these environments. Secondly, this research proposes to examine both the personal factors affecting the development of technical writing by ESL engineering students and the professional engineering norms applied in determining its acceptability. Finally, a discussion is presented of appropriate pedagogy that could ease ESL students' transition to becoming as equally proficient writers as the NES students who parallel their progress towards technical expertise.

1.8 Research Questions

The research investigates the following questions.

1. How do NES and ESL engineering students differ in their results in a task designed to assess their technical writing performance?

2. How does the writing performance of NES and ESL engineering students relate to their cultural and educational background?

3. What are the characteristics of the written work of second language engineering students with respect to the norms of their intended profession?

4. What contributions to ESP pedagogy are suggested by the findings of this research?

In sum, the thesis considers particular problems and challenges with the development of writing competence of second language engineering students and their integration into the field. In order to do this, both quantitative and qualitative types of methodology are employed in order to focus on contextual (academic and cultural) as well as textual (linguistic) features of the topic.

An overview of the interdisciplinary focuses and concerns relevant to this research is presented in Figure 1.1.

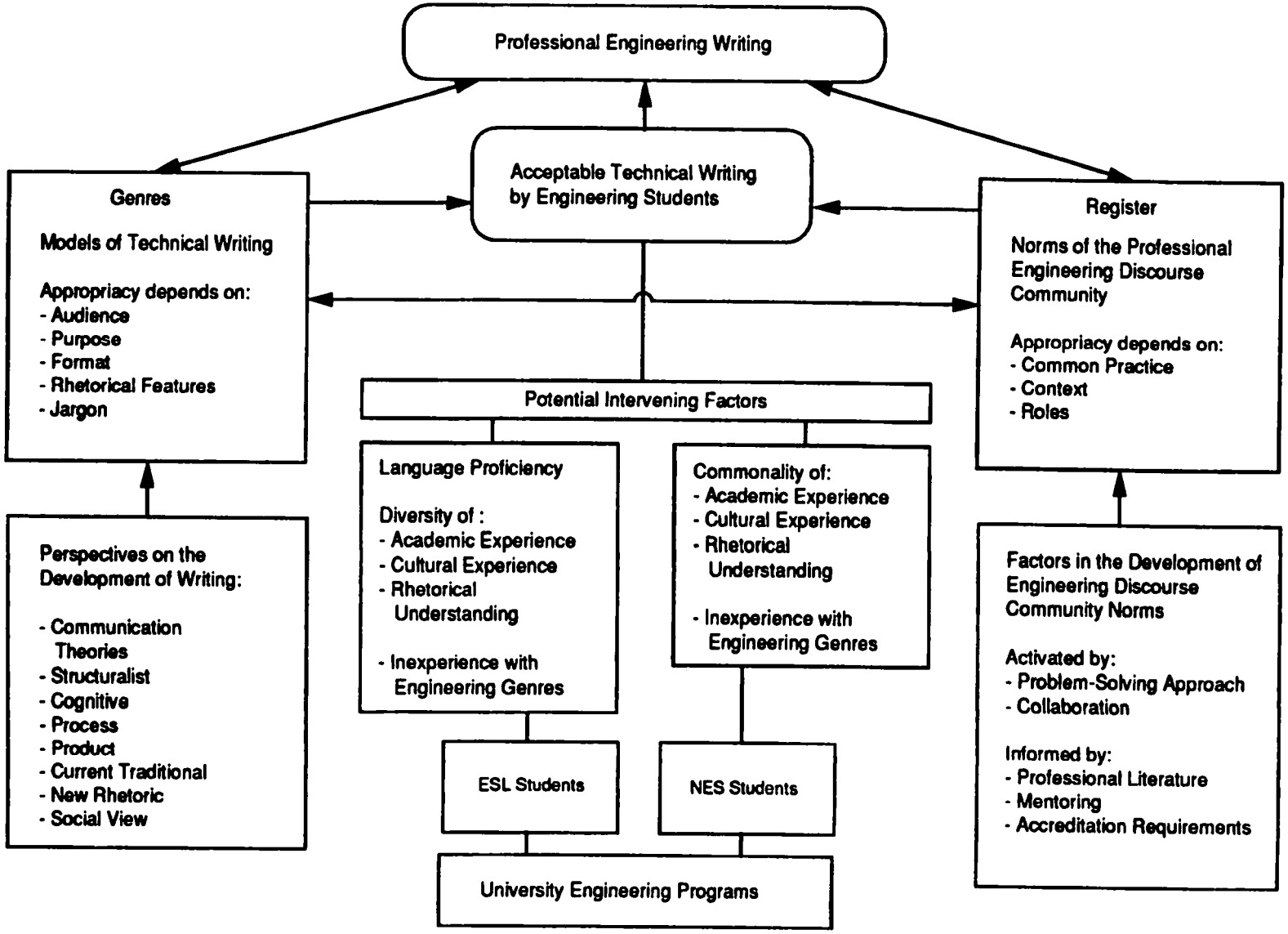

Figure 1.1. Major Interdisciplinary Focuses in the Research: The Acculturation of ESL Students to Engineering Writing

CHAPTER 2: METHODOLOGY

What are the factors that explain the acceptability of technical writing by second language students to the professional expectations of their field? This research undertakes to answer this question by assessing the writing of undergraduate engineering students. It analyzes their proficiency on a report-writing assignment, explores some background and personal factors that may have influenced their performance on the task, and describes the responses of professional engineers in assessing their writing.

2.1 Participants

The participants in this study were all adult volunteers. The majority were affiliated in some way with an Ontario university. In addition, a smaller group of participants were available from the local community.

2.1.1. Students

A Summer Engineering Report Writing Project (known here as the Writing Project) in the engineering faculty of an Ontario university generated an already established source of subjects for a comparative study of technical writing by undergraduate engineering students. A total of 220 students participated in the university's Writing Project that year, of whom 202 completed a questionnaire requesting personal demographic information for the separate purposes of this research. The final group of student participants included native English speakers (NES students, $n = 109$) as well as speakers who use English as a second language (ESL students, $n = 93$). Each of these groups included 17 females. The average age of the NES students was 20 years and for ESL students, 23 years.

Canadian-born students comprised 55% of the sample, students from Asia just over 14% and South-Asia just over 12%. Participants from Africa (7%), the Middle East (5%), Europe (5%) and Latin America (1%) comprised the rest of the sample. The ESL group of students included 28 mother tongues. Language groups with more than one representative each were Tamil, Chinese (Cantonese and Mandarin), French, Arabic, Somali, Persian, and Urdu. Twenty other language groups had only one representative each. The students were enrolled in all six programs of engineering available at the university at the time of the study: Areospace, Civil, Computer Systems, Electrical, Environmental, and Mechanical engineering.

2.1.2. Evaluators

There were two types of evaluators of the students' writing: Writing Project markers and professional engineers acting as assessors.

2.1.2.a Markers

The first group consisted of two markers from the Writing Tutorial Service (WTS) faculty as well as six graduate student writing tutors who were associated with various departments in the university, and who were working in the WTS for the year. The WTS graduate students working on the Writing Project were especially trained to help engineering students through the draft stage of their writing task, and then to evaluate the students' reports to generate course grades for submission to the Engineering Registrar. Several markers had been working for the Writing Project for several years and so were quite experienced in evaluating a variety of engineering student reports.

2.1.2.b Assessors

A letter was sent to all active members of the engineering faculty outlining the nature of the research and the importance of their involvement in the assessment of technical writing (see letter as Appendix A.) At the same time, solicitations were made to engineers working in industry, both in the public service and in private consulting and industry. All assessors were from the immediate community. Eleven professional engineers (all males) agreed to participate in the study: six from university and five from industry. The academic assessors included professors who had acted as undergraduate coordinators and other professors who had been involved in improving engineering student writing. The assessors from industry were engineers who included a corporate president and vice-president, an engineering Gold Medal Award winner, an engineering Research and Development Medal recipient, and a Member of the Order of Canada, all of whom take appropriate writing skills in engineering very seriously. The engineers' specialties included chemical, civil and environmental, systems and computer, electrical, and mechanical and aeronautical engineering, thus covering most of the fields represented by the student participants in this study.

2.2 Instruments

The main types of instruments used in this study were primary documents which were text-based and secondary documents which provided information related to the text-based documents and their writers.

2.2.1 Writing Project Reports

A yearly writing project to evaluate the report writing capability of engineering undergraduates had been initiated at the university several years earlier as a cooperative effort between the Faculty of Engineering and the university's Centre for Applied

Language Studies. This was supported by administration and professors who recognized the need to identify students who might need further assistance in developing writing skills before they faced their critical (and separate) fourth-year project report-writing requirements or entered a co-operative (work-study) program.

The Writing Project had been organized as a compulsory summer course credit which ran between first and second academic years of the program. The course credit constituted a requirement for graduation from the undergraduate degree and was usually expected to be completed by the middle of the second year. The Engineering Registrar's office and an engineering professor set up the topics and coordinated logistics for Engineering. The Coordinator of the Writing Tutorial Service housed in the Centre set up the marking team and the evaluation sheets, and oversaw the final assessments of the written reports. Students did not meet in a traditional course setting, but rather were handed the Writing Project requirements at the end of their Design course in the spring term and were expected to write the report on their own over the summer. The sole requirement for the Writing Project was to write a typed 10- to 12-page report on an assigned topic; reading materials were usually provided, although students could also conduct further library research to further understand the topic and support their report. Topics varied over the years, but were typically technical and rather specific in nature. Students were required to submit at least one draft before handing in the final set of two copies: one for marking and the other to be left intact for the WTS files.

Passing the Writing Project was compulsory for graduation from any undergraduate engineering program, and students who failed were required to do the Writing Project again the following summer. A minimum score of 18 points (60%) (i.e., the low end of the Borderline level) was required to pass the project and earn the necessary course credit. The final results on the Writing Project

narrowed to a pass-fail decision since the performance levels did not produce a distribution of grades.

There was no differentiation in the assessment of ESL students who were doing this project on the same basis as NES students. The Writing Project results of the evaluation of the reports served as the basis for analyzing the writing of the engineering students in this study; these are the reports referred to in this study

2.2.2 Questionnaires

Questionnaires were distributed to all students who wrote the Writing Project reports in order to determine the age, gender, mother tongue, national origin, educational details, work experience, status, residency in Canada of participants, and to obtain an understanding of their conception of technical writing. (See Questionnaire as Appendix B.)

2.2.3 Writing Project Evaluation Criteria

The evaluation criteria used in the Writing Project were available in a number of documents which could be considered secondary to, or supportive of, the student reports which constituted the central database for the research. The purpose and format of these other documents (evaluation and appraisal forms, letters, etc.) were dependent on the role of the participants and the focus of the analyses.

2.2.3.a Report Criteria as Presented on the Evaluation Sheets

The Writing Project reports had to comply with engineering report formatting, organization and language (models were provided). Students were expected to demonstrate both coherent and

logical thinking as well as appropriate writing skills. Therefore, a checklist of criteria in the form of thirty questions on evaluation sheets was used both by students as a self-editing guide to their writing and by project markers to assess the reports and assign final grades for the Writing Project. This helped reduce the dissatisfaction often felt by writers/readers when they can't pinpoint the precise problems with a report they feel is poorly written. (See a copy of the Evaluation Sheet Questions as Appendix C). The thirty questions presenting the criteria were grouped unequally into categories in order to facilitate understanding of the strengths and weaknesses apparent in the report. The categories were Content (nine questions), Organization (ten questions), Format (four questions) and Language (seven questions). The Content category included questions to ascertain whether the report writer had focused on selection criteria for recommendations to the problem posed by the Writing Project, discussed alternatives appropriately or recommended original solutions. Under the Organization category, the criteria questions referred primarily to elements of logical organization, title page, table of contents, and necessary sub-sections which stated the purpose, reviewed the alternatives, summarized and analyzed the recommendations, and included a properly formatted table that summarized the alternatives. In the Format category the criteria questions dealt primarily with pagination and aspects of sub-sectioning. Finally, the Language category focused on syntactic errors and aspects of style and language use. In responding to the drafts, the markers used a yes-no-partially scale. Later, in order to determine grades for the Writing Project, the markers tallied the answers on each evaluation sheet and then converted the scores to percentages which related to one of four performance levels: Distinction (90-100%), Pass (64-89%), Borderline (60-63%), i.e., passed but with a warning about weaknesses, or Fail (59% or lower). Passing the Writing Project constituted passing the course and earning the necessary credit. This detailed information on setting up and marking the Writing Project reports is presented here because the Writing Project procedures pre-existed and did not form part of the thesis

methodology proper. Instead, the reports, the student population and the results on the Writing Project constituted data sources made available for the current research.

2.2.3.b Assessors' Criteria for the Sample Subset as Presented on the Appraisal Forms

The Writing Project required students to write a report which recommended a solution to a problem. This task was similar to one required of engineers and the resulting technical report would therefore be familiar to the assessors as a genre. In order to evaluate the sample subset of twenty reports (described on p. 84), the assessors were given appraisal forms that included the same 30-question criteria on the evaluation sheets that had been used by the Writing Project markers. In addition, a new category on Professionalism was added to the assessors' appraisal forms in order to ask assessors more holistically about the level of professionalism of each report:

On the basis of this report only, would you:

31. hire the writer as a junior engineer?
32. say this writer has understood the requirements of professional technical writing?

Would you say this report is professional in terms of

33. Content?
34. Organization?
35. Format?
36. Language?

The first of the six questions was added to ascertain whether the assessors thought the report writer was potentially employable on the basis of his or her written report. The second professionalism question was included in order to elicit the overall holistic view of assessors on whether each report was acceptable as a technical

document. The four remaining questions focused on content, organization, format, and language in order to ascertain which category might been the basis for the holistic impression.

The assessors used a three-point scale in order to indicate to what extent the report writer had satisfied the question criteria: 0 for Not at all; 0.5 for Yes, but not well; or 1 for Yes, satisfactory. On a separate instruction sheet, the assessors were asked to judge whether each report had been written by an NES or ESL writer, on the basis of identifiable information available in the reports, and to give a reason for their decision.

None of the assessors received explicit training on how to interpret the criteria, but a few did request clarification of certain questions on their appraisal forms. The intention was to allow the assessors to judge the reports naturally from their own experiences as professional engineers.

2.2.3.c Assessors' Comments

The engineer assessors were invited to write additional comments for each report on their appraisal forms in boxes provided for each of the four categories. As well, they were encouraged to write comments on the reports since it was felt that these would signal areas worthy of further analysis or review.

2.3 Procedures with Data Sources

The procedures with the data sources varied according to the quantitative and qualitative analyses required.

2.3.1 Pilot Study

In order to assess the instruments and procedures for the thesis, a pilot study was conducted based on the current year's

Writing Project. Completion of a demographic questionnaire was requested. Because the students completed these questionnaires throughout the summer as they handed in their drafts to the Writing Project markers, the number of respondents to the questionnaire was 157, a response rate of 64%. Scores on the evaluation sheets were analyzed generally and separately for NES and ESL students. From the analysis of the demographic and Writing Project results, a sample subset of twenty reports was created. This subset was submitted to eight engineer assessors, four each from academia and industry, and results were analyzed primarily in terms of the viability of the instruments and methodology employed. As a result of a review of the pilot study, some modifications were made by the coordinator of the Writing Project to the marking criteria for the following year's Writing Project; as well, some changes were made to the research questionnaire, primarily as clarifications to the questions on educational experience and programs. Relevant findings from the pilot study are discussed in the Results and Discussion chapters.

2.3.2 Student Questionnaires

The questionnaires (Appendix B) for the thesis were distributed to the students registered for the Writing Project ($n = 220$) at the same time as they received instructions and information packages for the Writing Project. Participation was entirely voluntary and all students in the study signed a waiver. The questionnaires were assigned reference numbers matching the students' identification numbers; this permitted later analysis of their Writing Project results and subsequent selection of a sub-sample of reports for assessment by engineering professionals. Ambiguous cases, unregistered students and unsigned questionnaire forms were subsequently excluded: the final response rate was 92% ($N = 202$). Questionnaire data provided the first level of division between NES and ESL students for dividing the results shown on the Writing Project evaluation sheets.

2.3.3 Writing Project Research Reports and Performance Levels

After the Writing Project marks had been submitted to the Engineering Registrar, the unmarked copies of the final reports (n = 229) were made available for the current research by the Writing Project coordinator. In addition, copies of the students' scores on their corresponding evaluation sheets (listing the 30-question criteria) and the final results in terms of performance level (Distinction, Pass, Borderline, or Fail) were provided.

2.3.4 Sample Subset of Twenty Reports

A sample subset of the total NES and ESL reports was selected on the basis of purposive selective sampling (Nachimias & Nachimias, 1987; Patton, 1990) with the intention of balancing these two main groups not only demographically but also by performance levels. The subset of twenty reports ranged in length from eight to twelve pages of text, not including references and tables. Demographic data from the questionnaires were also balanced to the extent possible in order to include those variables that the pilot study had suggested were most useful. The pilot study had indicated that in order to best reflect the population of engineering students in the Writing Project, the sample subset of reports had to include at least ten NES and ten ESL writers representing the performance levels of Distinction, Pass, Borderline, and Fail. Other variables also had to be considered such as program data, gender, age, length of stay in Canada, and high school experience. (Demographic details on the sample subset of twenty reports are presented in Appendices D, E and F.) All personal identification and indications as to Writing Project results were deleted before the subset of reports were given to the assessors.

2.3.5 Assessors' Packages

The eleven assessors who agreed to evaluate the sample subset were listed by type (academic and industry) and given reference numbers. Assessors #1 to #6 inclusive were engineers who were full-time faculty at the university, while assessors #7 to #11 inclusive were industry engineers. The subset of twenty reports was submitted to the assessors along with twenty blank appraisal forms listing the criteria to be used in their assessment. (These will be referred to as the assessors' appraisal forms since they included the 30 questions on the original Writing Project evaluation sheets with six additional questions and space for comments.) As well, copies of the students' Writing Project instructions and a set of readings were given to the assessors in order to provide background information on the requirements. (See covering letters and instructions to assessors as Appendices G and H). All identification relating to the student's name, mother tongue, Writing Project result, and any other administrative information (e.g., student number, program) was removed before the packages were copied and given to the assessors.

Distribution of the reports to the engineer assessors was relatively easy; retrieval was not. The last assessor finally completed the evaluation of his subset of twenty reports two years later. Two others never completed, thus reducing the number of assessors to nine from the original eleven who had first agreed. A larger number of reports per assessor would have been impractical, given the time and effort required by the volunteer engineers to commit to this assessment. The alternative of reducing the number of sample subset reports per set (to reduce marking load) was not possible either, given the need to balance NES and ESL students' results on the reports (dependent variables) with the independent variables determined by the questionnaires.

2.4 Quantitative Analyses

The research presented here was a mixed method study which attempted to combine the insights gained from both quantitative and qualitative analyses. The primary focus, however, was a descriptive one. Within the quantitative realm the approach was one of observational methodology rather than experimental research. The intention was to understand not only whether there were similarities and differences in writing between NES and ESL students, but also why they occurred. For this reason, the terms *dependent variables* and *independent variables*, commonly used in experimental research, were not applicable (McCall, 1980). In no instance were variables manipulated in an effort to affect outcomes. The quantitative variables studied here were analyzed in terms of their apparent relationships. For example, the results for the reports from the Writing Project were related to information provided by the students about their personal backgrounds and preferences. In addition, a sample subset of these same reports were submitted to a group of professional engineers for their evaluations based essentially on the same criteria. Comparisons were made of different scoring decisions, but there was no control over any of the variables described.

2.4.1 Quantitative Analysis of Questionnaire Data

After the questionnaires were completed, the students' answers were coded in order to produce a data set of tabulations from which relationships and descriptive patterns could be inferred.

2.4.2 Quantitative Analysis of Evaluation Sheet Results

The results of the research reports had been scored on the evaluation sheets. Questionnaire data provided the first division of the scores for analysis on the basis of whether they had been achieved by NES or ESL students. This made it possible to analyze

the results from the Writing Project separately and later in conjunction with the data from the matching questionnaires. Only reports whose writers had completed the Writing Project and answered the survey unambiguously were included in the current research. The final sample thus included 202 unmarked reports and copies of their matching evaluation sheets.

Totals and means for the questions on the evaluation sheets were calculated and sub-scores were analyzed according to category focus areas (Content, Organization, Format, and Language). Scores for each of the thirty question-criteria listed on the evaluation sheets were analyzed to compare NES versus ESL students' scores for each question. In addition, performance levels (Distinction, Pass, Borderline, and Fail) and category scores were compared in order to determine the basis for the final report result (conceptual, organizational, structural, or linguistic). Most of the results of this analysis were directed towards answering the first research question, namely whether NES and ESL students differed in the way they attained their performance levels for their Writing Project reports. The analysis included a comparison of means and independent samples t-tests of the difference between those means, with an alpha value of .05.

2.4.3 Performance Levels Related to Questionnaire Data

Answers to the questionnaires were compiled, coded and totaled, primarily with regards to whether the respondents were NES or ESL students. This division then became a basis for comparison of demographic data in relation to the results (as performance levels) obtained on the Writing Project. A number of statistical analyses were undertaken in order to answer the second research question concerning the relationship between results on the Writing Project reports and demographic and other personal factors. The analysis included a comparison of means and standard deviations, independent t-tests of the difference between those

means and a one-way analysis of variance (ANOVA). For all tests of statistical significance the alpha value was .05.

2.4.4 Evaluation of Sample Subset of 20 Reports by Engineer Assessors

When the engineer assessors had completed the evaluation of all twenty reports in the subset (generating a total of 180 completed appraisal forms), both their quantitative and qualitative assessments were analyzed in terms of NES versus ESL students' reports and in terms of academic versus industry engineers. The assessors' quantitative scoring of the criteria on the appraisal form for each report was analyzed by comparing:

- the scores generated for each report;
- the means generated by the assessors for each report to the Writing Project markers' scores;
- the means for each category (Content, Organization, Format, and Language);
- their means for the 30 questions with their answers to the first professionalism question (on hiring the report writer);
- the scores for the original 30 questions with the assessors' answers to the other five questions on professionalism; and
- the accuracy rate in judging whether each student was an NES or ESL writer with the scores assigned each report.

An analysis of the academic and industry assessors' scoring as compared with the scoring from the Writing Project markers was conducted using Pearson Correlation Coefficients and independent and paired samples t-tests. For all tests for significance an alpha of .05 was used.

In order to determine whether the engineers were making hard, easy or balanced assessments, the scores for each report were analyzed per assessor to see if they were following similar or consistent marking practices. This was done by comparing each

assessor's scores for each report as well as their individual means for the twenty reports. The variability or consistency of scoring decisions would provide some information about whether the assessors were drawing on the same underlying assumptions about acceptable technical writing and whether each assessor maintained a constant standard of acceptable technical writing when making his own evaluations.

2.5 Qualitative Analyses

The qualitative approach focuses on the information provided by the students and assesses its patterns descriptively in conjunction with the quantitative analyses. The responses of the assessors to the sample subset of reports are similarly described in terms of their own status and the way they project these responses. The description and possible reasons for their assessment of the sample subset of student reports then become the basis of the interpretations.

2.5.1 Assessors' Comments on the Texts

Both the assessors' appraisal forms and the covering instructions invited additional comments by the assessors, since it was felt that these would signal areas worthy of further analysis or review. In addition, assessors were encouraged to write on the reports themselves or mark them in any way. The elements of the reports so highlighted by the assessors' comments were:

- transcribed and categorized according to the criteria categories;
- examined for regularities or commonalities;
- compared to the scoring of the reports by both Writing Project markers and assessors;
- identified as particularly salient to either NES or ESL report writers; and
- analyzed in terms of genre and discourse features

All comments written by the assessors were compiled and categorized according to the appraisal form categories (Content, Organization, Format, Language, and Professionalism) and analyzed by assessor type (academic or industry) and by NES or ESL student reports. Comments or written signals (e.g., "huh?", "!") that could not be easily placed into one of the four categories were listed as unknown rather than potentially misplaced and so were not included in this part of the discussion. At times, the assessors may have evaluated an aspect of the report that might not strictly have been covered by the category. The decision was made that such comments were analyzed in situ, since they demonstrated the assessor's individual interpretations or understanding of the category.

2.5.2 Assessors' Reasons for Deciding Whether the Report Writers were NES or ESL Students

The reasons provided by the assessors in guessing whether a report had been written by an NES or ESL writer were compiled and compared to the actual status of the student, and then analyzed in order to determine recurring patterns or striking differences. The comments were also analyzed in conjunction with other evidence (scores, comments, hiring decision) to determine if there was consistency in the application of the assessors' judgments.

2.5.3 Genre Analysis of Assessors' Comments

All the comments written on the reports by the engineer-assessors were assessed in light of the framework provided by genre studies and to a lesser extent by the perspectives suggested by the theories on the social views of writing. It was anticipated, as indicated by the pilot study, that many of these comments regarding the appropriacy of the technical writing of engineering students would not only be directed towards specific linguistic elements or features directly linked to the text, but would also reveal the

assumptions and expectations concerning appropriacy that were more cultural or professional in nature. The comments made on the reports would likely go beyond the checklisted criteria (some of which also deal with profession-specific aspects). They would also probably reflect the standards of effective technical writing which are highly contextualized and constrained by the practices and models generated within the engineering profession. It was anticipated that the appropriacy of the technical writing of these engineering students would be judged not only on the basis of language or format but also on professional acceptability, specifically in terms of whether the students' writing proficiency had satisfied engineering's entrance requirements for moving them into a professional discourse community. The differences between first and second language writers in such evaluations would be particularly interesting, since these judgments could be compared to other factors identified through quantitative analysis.

The types of comments were then categorized according to whether they related to text, discourse or genre concerns. If the comments referred to formal features (related to lexico-grammatical accuracy), the reader had focused on text. If they related to elements of meaning systems and logical relationships, then discourse was the probable focus, encompassing all its specific elements, ranging from organizational patterns to cohesive devices. The comments directed towards overall appropriacy (e.g., in organization, focusing or tone) or about content development would likely relate to socio-professional assumptions, i.e., be related to genre (Bazerman, 1994; Berkenkotter & Huckin, 1995; Dias et al, 1999; Freedman & Medway, 1994b; Swales, 1990). This kind of categorization is a crucial first step to understanding how closely these student writers approximate professional report writing norms, according to the engineers' perceptions of their manifestation. The specific identity and role of these components would emerge through the examination of both the reports (in terms of performance levels) and the assessors' comments.

2.6 Summary of Methodology

In summary, the decisions made regarding methodology and focuses for this research were dependent on the following factors:

- the availability of large numbers of similar data (Writing Project reports), generated within
- the same setting and circumstances (a specific undergraduate university engineering course required for credit) which provided
- a reasonable balance in the number of reports written by NES and ESL students in the Writing Project, who also agreed to complete questionnaires, which generated
- opportunities for both quantitative analysis (scores on the evaluation sheets for the Writing Project reports and on the appraisal forms used by the assessors; questionnaire data about demographics), and for
- qualitative analysis (commentary on the appraisal forms, on the reports and information from the questionnaires), and finally the opportunity to benefit from the
- time and effort volunteered by engineering professionals (academic and industry) to assess the reports.

Results of this investigation are presented in the following three chapters, with subsequent discussions in Chapter 6. The following two pages present a list of the terms used in the study (Figure 2.1) and a flow chart (Figure 2.2) outlining the process of document management and analyses.

Figure 2.1 Terms Used in this Research, Listed in Methodological Order

Writing Project - Summer Engineering Report Writing Project, a compulsory one-credit undergraduate engineering summer course which did not, however, meet in scheduled classes but instead required the writing of a single engineering report by the fall. A pass-fail system rather than grades was used to evaluate reports for the course credit, although performance levels were also determined to assess overall proficiency in writing.

Reports - Technical reports produced by undergraduate engineering students in the Summer Engineering Report Writing Project, made available for this study

Evaluation Sheets - Guideline documents for students that presented criteria (in the form of questions) for writing the reports; also used for marking and final grading of the Summer Engineering Report Writing Project reports

Categories - Grouping of the questions/criteria under the headings Content, Organization, Language, and Format

Scores - Tallied marks from the Evaluation Sheets which were converted to Performance Levels

Levels - Descriptive performance ranks of Distinction, Pass, Borderline, and Fail used in the marking of the Reports

WTS - Writing Tutorial Service faculty and graduate students who acted as markers for the Summer Engineering Report Writing Project

Population - Undergraduate engineering students who wrote Writing Project reports

NES - Native-English-Speaking Students

ESL - English-as-a-Second-Language Students

Questionnaire - Form requesting demographic and academic information from students in the Writing Project

Students - Students who both wrote the report for the Writing Project and who had also voluntarily completed a questionnaire; excludes those who were omitted for methodological reasons (e.g., ambiguity about mother tongue, not registered, not signing waiver)

Sample Subset - Set of twenty reports selected for submission to Assessors for independent evaluation

Assessors - Professional engineers who evaluated sample subsets of twenty reports; called Academic or Industry Assessors to identify prime workplace roles

Appraisal Forms - Modified evaluation sheets used by Assessors, which included the original 30 criteria as well as six additional questions on professionalism

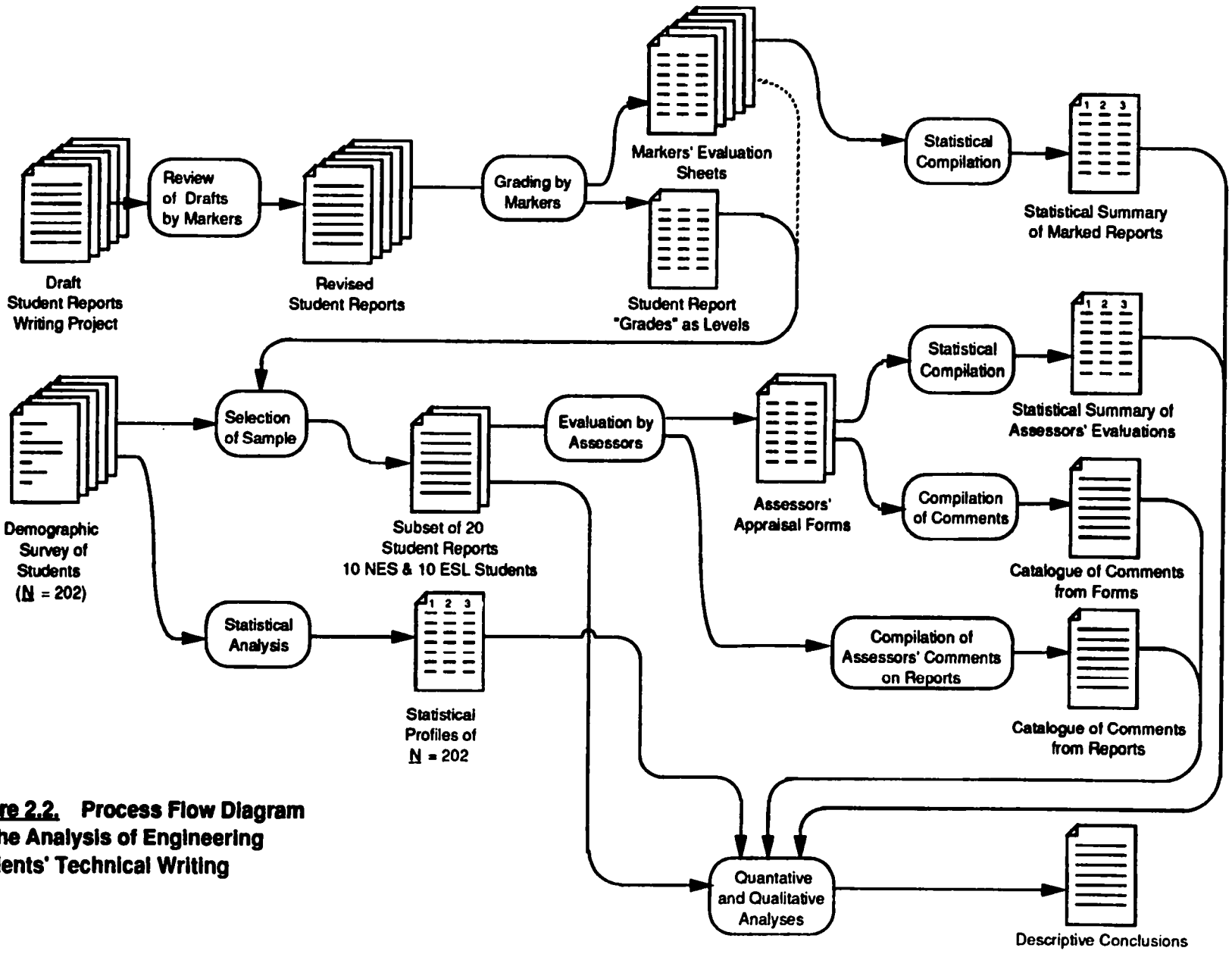

Figure 2.2. Process Flow Diagram for the Analysis of Engineering Students' Technical Writing

CHAPTER 3: RESULTS OF THE ANALYSIS OF THE WRITING PROJECT EVALUATION SHEETS

In response to the first research question, this chapter aims to identify those components of the Writing Project report writing task which were salient in differentiating between NES and ESL writers. This was done through analysis of the scores on the evaluation sheets presenting criteria in the form of thirty questions. For this set of analyses, the questionnaire data was used for a first-level division of the report writers solely on the basis of their being NES or ESL students. All other demographic details about the student participants are provided in the Methodology chapter section 2.1.1, pp. 75-76. The analysis considered the overall scores of all students; it then looked at the results for each category (Content, Organization, Language, or Format) and for specific questions within each category which produced different scores for NES or ESL writers. Finally, the distribution of NES and ESL student results across the performance levels (Distinction, Pass, Borderline, and Fail) was analyzed, both generally and with reference to the categories.

3.1 Scores for Participants (N = 202) on the Evaluation Sheets

The undergraduate engineering students who both wrote the report and completed the questionnaire, thus giving permission for their Writing Project results to be analyzed, numbered 202, comprising 109 NES students and 93 ESL students. The questions on the evaluation sheets had been grouped in categories focusing on content, organization, format, and language.

Figure 3.1. shows the distribution of mean scores on the Writing Project, comparing the results for NES and ESL students' reports.

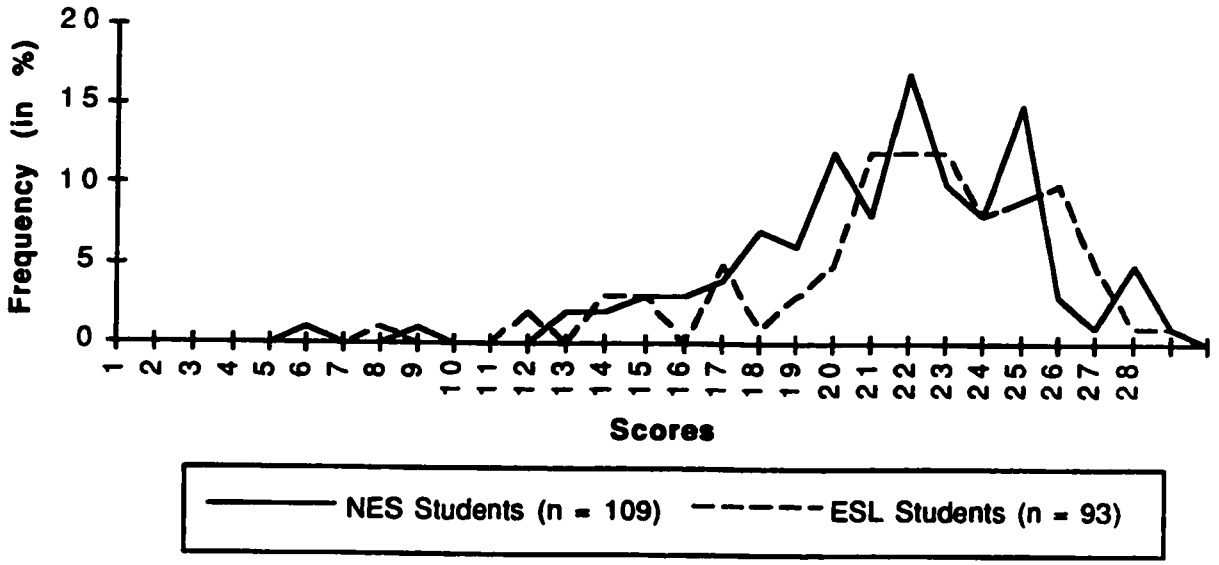

Figure 3.1 Distribution of scores on the Writing Project compared by NES students (n = 109) ESL (n = 93) students. The minimum passing score is a low Borderline score of 18/30 points (60%).

Table 3.1 shows the distribution of NES and ESL students in each of the four performance levels:

Table 3.1
Distribution of NES and ESL Students Across Performance Levels

	Distinction (90-100%)	Pass (64-89%)	Borderline (60-63%)	Fail (0-59%)	Totals
Students:	n (%)	n (%)	n (%)	n (%)	n (%)
NES	7 (6)	73 (67)	13 (12)	16 (15)	109 (100)
ESL	7 (8)	68 (73)	4 (4)	14 (15)	93 (100)
Totals	14 (7)	141 (70)	17 (8)	30 (15)	202 (100)

Table 3.1 shows that the distribution of NES and ESL students across performance levels was similar. One exception to the similarity in numbers per level was the low number of ESL students

($\underline{n}$ = 4, or 4%) at the Borderline level in comparison to the 13 NES students (12%) at the same level.

The scores for NES and ESL students were essentially the same when viewed as means in each performance level. The mean for the population of 202 students was 72% (Pass); the mean for NES students ($\underline{n}$ = 109) was 71% and for ESL students ($\underline{n}$ = 93) 73%. Each of these means was at the Pass level. NES and ESL students scored generally the same when viewed as two distinct groups, both in their means and within the proficiency levels. This suggests that according to the criteria and the assessment procedures of the Writing Project there appeared to be no difference between ESL writers and NES writers. However, when looked at on a specific question basis within performance level groupings some patterns of difference arose which will be considered in more detail later. A descriptive review of the general profile of scores for the report questions is first outlined below with regards to areas of weakness and with reference to the NES and ESL student groups.

The questions which earned low percentages showed that many students demonstrated report writing deficiencies according to the criteria related to the following: poor control of content, especially with regards to systematic analysis of alternatives, focusing on recommendations, recommending original solutions, and referencing; to unsatisfactory organization of the data into a table; and to errors in spelling and grammar, along with some lack of brevity.

The criteria for which there were the greatest differences between NES and ESL mean scores (from 7% to 25%) related to the core of the content and the recommendations, and then aspects of language, namely grammar, brevity and narrative style. ESL students' scores showed weaknesses in conceptual aspects and language, but strengths in aspects of organization and simple inclusion of required items.

3.2 Performance Level Scores by Category

The means for NES and ESL students showed a similar profile but certain questions showed a variance between NES and ESL students' results. Within the focus categories (Content, Organization, Format and Language), there were additional differences in their scores. NES students showed a higher set of means for all levels within the Content and Language categories except for the Pass level within Content. Yet ESL writers, including those students at the lower performance levels, had higher scores in the Organization and Format categories.

T-tests of the means for both NES and ESL students were conducted for each category (Content, Organization, Format, and Language) by performance level (Distinction, Pass, Borderline, and Fail). Three of the categories showed no significant differences. However, the fourth category, Organization, was an exception, where the ESL students, on the whole, obtained significantly higher means. The means for the Content category showed a consistent pattern of NES students surpassing ESL students, except in the Pass group. In Organization, on the other hand, the ESL students' means were all somewhat higher, especially in the Borderline category (but the number of ESL students is low here: $n = 4$). The significant difference between NES and ESL students in Organization was important since it confirmed the suspicion that the maintenance of comparable total scores by the ESL students was due in some measure to their higher scores for this category.

Greater clarification was possible when these patterns (lower scores per question and differences between NES and ESL students) were considered on the basis of each of the four categories on the evaluation sheets, as outlined below.

3.3 Question Analysis by Category of all Evaluation Sheets of NES and ESL Students (N = 202)

This section considers the evaluation sheet results in terms of the four categories (Content, Organization, Format and Language) into which the thirty criteria were grouped. In order to appreciate the scores within the criteria category, it is necessary to remember the score ranges for each performance level, namely, Distinction, 90-100%; Pass, 64-89%; Borderline, 60-63% and Fail, 0-59%. The following describes the results of the evaluation sheet scores within each category in terms of performance level. (See Appendix I for details.)

3.3.1 Content

(Maximum score was 9 points for this category)

For the NES writers (n = 7) and ESL (n = 7) writers in the Distinction performance level, the scores for each of the nine questions on Content were basically the same. The NES students mean score at the Distinction level was 92% and for the ESL Distinction students was 86%. The only question with any great variation between NES and ESL Distinction scores was #6 ("Do you recommend your own original solution/s?"). Here there was a substantial difference between 71% for NES students and 29% for ESL students. In fact, this question on originality showed poor results (i.e., failed) for all performance groups and was always lower for the ESL students, sometimes by a very high margin.

For the group in the Pass performance level there was general consistency for most question-criteria dealing with content. However, there were very low scores for question #6 (on original solutions) with 26% for NES students and only 18% for ESL students; in addition, question #7 (focusing on recommendations) indicated a difference of more than 20% between NES and ESL students, but with the results for NES students on the low side this time with 52% compared to ESL students' score of 75%. In other areas of Content,

results for NES and ESL students in the Pass level were similar; question #4 (discussion of alternatives with reference to criteria), for example, had Borderline scores of 62% for both NES and ESL students, while question #9 (reference to sources) was failing at 58% for NES students and 57% for ESL students.

Students in the Borderline level showed even worse results in the Content category, but numbers for ESL students at the Borderline level ($\underline{n} = 4$) were too low to warrant much discussion. Neither NES nor ESL writers presented the report criteria clearly (question #1). There was, in fact, a dramatic decline for both NES and ESL students on this question compared to the Pass level, falling for NES students from 85% to 46% and for ESL from 84% to 50%. All the questions on Content for the Borderline level scored low except #3, review of alternatives, at 100% for both NES and ESL students. Question #6 (original solutions) showed the most difference in Content, with NES students at 38% but ESL students scoring at 0% for this question.

Results for students in the Fail group were consistently lower on Content questions than on all the other category questions. The Fail group's highest score was for the question on which all other groups also did well (#3, review of potential alternatives). This question scored high for both NES students in the Fail level (81%) and ESL students in the Fail level (93%) since it was the expressed focus of the instructions for the report writing project. As could be expected for the group that failed, question #6 (original recommendation) showed the lowest scores for both NES students (13%) and ESL students (7%).

More telling differences were discernible when the students in Distinction and Pass were combined (on the basis of acceptable rating at versus unacceptable rating at the two lower performance levels). In this re-grouping based on general acceptability, there were 80 NES students and 75 ESL students, which allowed for more equitable comparisons. In this case, the Content category questions which showed the most difference between NES and ESL students were only #6 (recommending an original solution): NES students,

$\bar{x}$ = 30%, ESL students, $\bar{x}$ = 19%, and #7 (focusing on recommendations) with NES students, $\bar{x}$ = 56% and ESL students, $\bar{x}$ = 77%. Question #9 (reference to sources in the text) was at a low Borderline level for this upper group with NES students at 61% and ESL students at 60%.

When the students in the Borderline and Fail levels were combined, then the results for NES students (n = 29) and ESL students (n = 18) differed most for three criteria, namely #2 (balanced amount of background information: NES students, $\bar{x}$ = 38%, ESL students, $\bar{x}$ = 50%); for #5 (systematic explanation of the recommendations: NES students, $\bar{x}$ = 38%, ESL students, $\bar{x}$ = 22%); and for question #6 (recommending an original solution: NES students, $\bar{x}$ = 24%, ESL students, $\bar{x}$ = 6%).

3.3.2 Organization

(Maximum score was 10 points for this category)

In terms of Organization, both Distinction and Pass groups of NES and ESL students scored consistently high for all ten question-criteria, with the exception of #19 (a proper table on alternatives). Oddly, the NES Distinction writers only averaged 29%, while the ESL students showed 86% for this question; since there were seven students in this level this was a major difference. For other performance levels this criterion also showed failing means, ranging from 58% (by Pass-level NES students) to 14% (by Fail-level ESL students).

The students in the Pass level had generally the same means for each of the criteria on the Organization category with the exception of #19 noted above. For a number of questions, the NES students' mean score was somewhat lower than that of the ESL students, the major difference being for question #14 (on summarizing the recommendations) with NES students averaging 68% and ESL students, 76%.

It was the Borderline group that showed the most discrepancy between NES and ESL students in the Organization category, but because of the low number of ESL students ($n = 4$) the interpretation must be very tentative. For four of the questions (10, 13, 17,19), the ESL group scored quite a bit higher, but fell dramatically lower for question #14 (point-form summary of recommendations), with NES students showing a result of 46% and ESL students a result of 0% overall for this question. Having a proper table (#19) showed reverse strengths, with NES students at only 15% and ESL students at 50% for this question. Even when scoring generally higher for organizational aspects, when it came to conceptually synthesizing the content effectively, the ESL students did worse in this transitional level.

The Fail group scored low on the same questions within the Organization category as did the Borderline group, with the ESL group again producing slightly higher results for some questions. Low scores for NES students (13%) and ESL students (0%) on question #19 (table) indicated that this very basic requirement of the report was poorly understood or poorly executed. Whether this related to a reduced ability to process instructions, to a lack of understanding of the terms or requirements themselves, or to poor language proficiency cannot be determined. Overall, however, one can state that NES and ESL students who failed the report in the Organization category did so at similar questions, though each to a slightly different degree.

When Distinction and Pass students were combined, so that numbers were more similar for each group (NES students $n = 80$, ESL students $n = 75$), specific questions stood out even more as scoring differently for NES and ESL students. These questions showed the comparative strength for ESL students in the category of Organization, as for example, in question #10 (overall organization): NES students had 74% and ESL students had 84%; #14 (summary of recommendations): NES students, 71% and ESL students, 79%; and #19 (a proper table): NES students 24% and ESL students, 32%. This

last criterion was particularly difficult; only ESL students in the Distinction level passed this question at 86% with all other students failing it, yet ESL students had higher scores than NES students at Pass and Borderline levels, only then dropping to 0% in the Fail group. Thus, ESL students were better on most questions in the Organization category overall and specifically higher for the questions cited here.

However, when Borderline and Fail students were combined for each mother tongue group (NES students $\underline{n} = 29$; ESL students $\underline{n} = 18$) and viewed as a percentage of their mother tongue group at this amalgamated lower level, ESL students did not fare as well. The questions for which NES and ESL students differed the most were the following: #14 (summary of recommendations): NES students' result was 28%, ESL students' result was 17%; and #17 (analysis of recommendations): NES students' result was 41%, ESL students' result was 56%. Question #19 (a proper table) generated a low response rate for both groups; namely, only 14% of the NES students at the lower levels managed to create a proper table, and only 11% of the ESL students did so. In sum, despite their similar means, NES and ESL students at the two lower performance levels differed significantly at some key areas of organization.

3.3.3 Format

(Maximum score was 4 points for this category)

The Format category was not problematic for any of the four performance groups, except for those who failed. Questions #20 and #21 garnered 100% or very high for almost all levels. Both NES and ESL students in the Distinction and Pass levels had essentially the same high percentage means in the Format category. At the Borderline level, however, only half of the NES students scored well for questions #22 (numbering the sub-sections) and #23 (appropriate headings). These questions were also problematic for students in the Fail group, where NES students managed 44% for #22 (numbered sub-sections) but ESL students got 64%, while for #23

(headings reflect section content) NES students averaged 50% and ESL students scored 29%. ESL students did better when following explicit guidelines, but did worse in conceptual aspects of formatting.

Combining Distinction and Pass groups, so that NES students $\underline{n} = 80$ and ESL students $\underline{n} = 75$, ESL students' results were higher only for question #23 (headings reflect content of the sections): NES students got 80% and ESL students got 87%. A look at the combined group of Borderline and Fail students (where NES students $\underline{n} = 29$, ESL students $\underline{n} = 18$) showed they continued the pattern, already described for other categories, of more visible difference between NES and ESL students for specific questions, with ESL students being higher than NES students, in this case for questions #22 (numbered sub-sections): NES students got 48% but ESL had 72%; and lower for #23 (headings reflect the content of the sections): NES students got 52% and ESL students got 39%. All students managed basic format requirements but poorer students did worse on those elements that required appropriate topic focusing and understanding of sub-topics. Upper level ESL students managed to gain points overall through proper formatting but lower-level ESL students lost points even on format when this specific criteria of this category related to conceptual aspects.

3.3.4 Language

(Maximum score was 7 points for this category)

It was in the area of language control that a stronger pattern emerged across performance levels and showed differences between the results for NES and ESL students. The question on parallelism (#25) had low means (i.e., failed) all across the levels for both NES and ESL students, with only NES students at the Distinction level showing 100% (the ESL students in the Fail level had 7%). Even the ESL students who were at the Distinction level faltered in spelling, grammar and brevity, falling to a low Pass level of 71% on these questions. The Pass level groups diverged on some questions on

Language, with ESL students' results higher than NES students' results for brevity, avoiding narrative style and avoiding inappropriate language. In spelling and grammar, however, the ESL students were quite a bit lower; in fact, even at the Pass level the ESL students failed in grammatical control at 32%. Borderline writers were more consistently poor for Language across the levels for ESL students and NES students except for question #24 (avoiding personal pronouns). Means for the ESL Borderline students were lower than those for the NES Borderline students. However, at the Fail level, ESL writers showed a marginally higher proficiency over NES writers in the areas of avoiding personal pronouns, being brief, and avoiding narrative or inappropriate style.

Finally, in combining Distinction and Pass students (NES students $n = 80$, ESL students $n = 75$) for the Language category, three questions showed marked differences. ESL students' scores were lower for question #26 (spelling mistakes: NES students got 83% and ESL students got 69%) and for #27 (grammatical errors: NES students had 59% and ESL students had 36%). When Borderline and Fail level students were combined, this pattern of difference in means continued for ESL and NES students for question #26 (spelling): NES students' mean score was 72% and ESL students' mean score was 33%); for #27 (grammatical errors): NES students got 55% and ESL students got 22%; and for #29 (avoiding narrative style: NES students got a mean score of 41% and ESL students got 33%).

The analysis of the NES and ESL students' scores on the evaluation sheets which had been used to determine their results on the Writing Project helped to set the foundation for the research. The apparent similarity in writing proficiency between NES and ESL undergraduate engineering students seemed to rest on different strategic bases. The extent to which these results, in terms of performance levels, were related to their personal and educational background was subsequently analyzed.

3.4 Analysis of Performance Levels Related to Demographic Variables

The previous section laid out a comparison of quantitative results for NES and ESL students whose specific scores on the Writing Project were generated by responses to a set of thirty questions grouped according to categories (Content, Organization, Language, and Format), and which resulted in a descriptive evaluative ranking, or performance level (Distinction, Pass, Borderline, or Fail). In conjunction with the profile of their strengths in linguistic, formulaic and conceptual features highlighted by the scores on the evaluation sheets, data on non-linguistic features would expand the description of this group[1] of engineering undergraduates as technical writers and would help to enhance teachers' understanding of these students. Therefore, the textual and social elements of the technical writing proficiency of NES and ESL engineering students were considered for the second research question:

> How does the writing performance of NES and ESL engineering students relate to their cultural and educational background?

Statistical tests were applied where appropriate and qualitative analyses of patterns in the distribution of results were undertaken. In general, there were few statistically significant relationships between the performance level results on the Writing Project for NES and ESL students and their demographic and academic backgrounds.

The analysis of the relationship of the performance levels to the variables generated by the questions on the survey showed that the results could be divided into three types: 1) having no statistical

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[1] Students' names, phone and student ID numbers were only used to keep track of data as it was put into the databases. No student was further investigated or contacted. All students used in the sample had voluntarily signed a permission waiver; those who had not were excluded from the study.

significance and low descriptive interest; 2) showing moderate, minimal or even no statistical significance but with some descriptive interest; and 3) both statistically and descriptively interesting.

3.4.1 Demographic Variables with No Statistical Relationship to Performance Levels and Low Descriptive Interest

Analyses of the performance levels with the following variables showed that there was no statistically significant relationship between them, and that descriptively any patterns in their distribution were of no particular interest outside of the few notes presented here.

Age. The average age of all subjects was 21 years, with NES students averaging 20 years and ESL students averaging 23 years.

Knowledge of other languages. NES students and students who spoke English in addition to their mother tongues reported knowledge of other languages to approximately the same extent, ranging between zero and four additional languages. No statistical relationship between the students' scores and the number of other languages they reported could be noted.

Work experience. Few of the 202 students reported work experience. About a fifth of NES students had worked, mostly in Canada. About a sixth of the ESL students reported work experience, mostly from outside Canada.

Citizenship status. Most of the ESL students (86%) were Canadian-born or naturalized citizens, or landed immigrants. Their scores showed no relationship to their status.

Previous education. The reason for the three-year age difference noted above between NES and ESL students may be partly attributable to the fact that a large number of foreign-born ESL students had completed a final year of high school in Canada instead

of moving directly from high school graduation in their country of origin into a Canadian university.

3.4.2 Demographic Variables with Some Statistical Relationship to Performance Levels and Moderate Descriptive Interest

The second set of variables generated by the questionnaire showed some or moderately interesting statistical results as well as some descriptively interesting patterns in their distribution. These findings are presented in more detail below.

Mother tongues. A complete list of the students' mother tongues and related performance levels is presented in Appendix J.

When considered on a performance level basis, the numbers were too low to be analyzed confidently for any mother tongue other than English and the four groups with the most representatives: Tamil, Cantonese, French and Mandarin. Analysis of the mean scores for the major language groups showed no substantial differences among them. Descriptively, however, some findings can be noted: Of the four largest language groups, the range for the Canadian-born French-speaking students most closely resembled that for the NES students. The distribution across performance levels of Tamil-speaking students and those in the two "Chinese" mother tongue groups of Cantonese and Mandarin (when combined) showed similar profiles, although there were slightly more students in the Fail level from the Chinese group.

Regions of origin. The 202 students came primarily from Canada (and included one from the U.S.A.), Asia (including Hong Kong, China, Vietnam, Malaysia) and South Asia (including India and Sri Lanka). An analysis of results by region of origin was undertaken according to NES and ESL students. (See Appendix K for a complete listing.)

Although no statistically significant differences were observed in performance levels across countries or regions of origin, an examination of the distribution did show some interesting trends.

Students from Canada were about equally represented in each performance level, except in the Borderline level, where they represented a higher ratio of their group than students from other regions did of their groups. Students from Asia and South Asia were poorly represented in the Distinction level, despite their relatively higher number within the whole group of ESL students. Students from the Middle East and Africa were over-represented at the Distinction level, relative to their proportion overall.

Time in Canada (ESL students only). Of the 109 NES students, seven were born outside of Canada but were not analyzed separately. The number of ESL students who were not born in Canada totaled 81 (or about 74% of the 93 ESL students). The average time in Canada for non-Canadian-born ESL students was 5.9 years. More than two-thirds (69%) of these ESL writers had been in the country six years or less while a smaller group had spent almost all of their lives in Canada. Appendix L shows the distribution of years for both foreign-born and Canadian-born ESL students in relation to their performance levels. The correlations observed when the Pearson Correlation Coefficient was calculated to determine the relationship between time in Canada and total scores on the Writing Project were essentially non-existent.

The mode (most frequently reported length of residency in Canada) was just over three years. Non-Canadian-born ESL students who were in the Borderline or Fail levels had reported modes of 2.9 years and 3.3 years respectively. This length of time was shorter than the time of those in the Pass level (a mode of 5.5 years). However, the Distinction group did not support this pattern of fewer years with lower performance levels since the mode for these seven students was just 3.3 years, partly explained by the recently arrived visa students who were in the ESL Distinction group.

Canadian high school experience. A large number of ESL students had received at least some part of their high school education in their country of origin rather than in Canada. Of the group of ESL students, 19 (20% of total) reported having only a single year in the Canadian

system, mostly for Ontario OACs[2]. Eleven ESL students reported having no Canadian high school at all but more than half of these had taken their high school abroad in the English language. This means almost a third of the ESL students had a year or less of Canadian high school but still received at least some of their secondary school instruction in the English language. Another third of the ESL group had four years or more Canadian high school experience, but this large proportion includes the 12 Canadian-born ESL students.

About half of the ESL students also included some non-Canadian high school time in their experience, even if it meant increasing their years of high school education. Of the 93 ESL students, 81 (87% of the full ESL group) attended Canadian high school for between one and six years. Of these 81 students, 65 (80%) attained a level of Pass or higher. The relationship between years of Canadian high school and total scores was statistically negligible for both the NES and ESL students, again largely due to the number of small cells that had to be considered. Nevertheless, certain relationships in the distribution of the results with the number of years in Canadian high school were suggestive. For example, 11 of the 18 ESL students with Borderline or Fail results had only been in the Canadian high school system between 0 and 3.5 years.

Other descriptive anomalies in the educational histories of some ESL students can be noted: One group of ESL students ($n = 14$) reported an inordinately long period of secondary education--up to eight years in some cases. The students in this same group also were older, had delayed the Writing Project or repeated the requirement, and a few had again failed the Writing Project this time around. These long-time secondary school sojourners were primarily from two major language groups: seven were Chinese and five were Tamil speakers, the other two students being Somali and Persian speakers.

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2. These are Ontario Academic Credits, generally equivalent to grade 13; most other provinces have a four-year high school program ending after grade 12.

In short, the findings suggest that ESL students with only limited Canadian high school experience may experience some measure of difficulty in this writing task, while those with longer years in an English secondary system seem to eventually attain the necessary academic standing.

Engineering program. There were six engineering programs of study represented in the Writing Project; however, NES and ESL students were not distributed evenly across the programs. There seemed to be a relatively clear preference for Aerospace engineering by NES students compared to ESL students at a ratio of 4:1, as there was for Environmental engineering (also at 4:1) but numbers were too low to be noteworthy here. Almost two-thirds of the ESL group favoured Electrical/Electronics and Computer Systems, while only one-third of the NES students had made these choices.

The ratio of students in each engineering program in this study was very similar to the ratio of the full undergraduate engineering program (as reported for the 1996-1997 year by the university's Office of Research and Statistics). The description of NES and ESL students was necessary to show that they were not evenly balanced in their selection of engineering programs in this study. It was therefore important to assess their performance levels on the basis of their individual profiles, as represented by their percentages within programs rather than simply across all programs.

The distribution of performance levels across programs of study presented some noticeable patterns rather than strong relationships. Only the Civil, Environmental and Electrical programs showed marked differences in the distribution of performance levels for NES and ESL students. For instance, the NES students with a Distinction level were fairly well spread across the programs, except in Electrical, whereas the ESL students with Distinction were concentrated in Electrical, with some in Computer Systems. Since there were seven students with Distinction results in both NES and ESL groups at this level, this disparity was not a factor of their comparative sizes.

3.4.3 Demographic Variables with Stronger Statistical Relationship to Performance Levels and High Descriptive Interest

The final group of demographic variables showed stronger statistical relationships to the performance levels obtained by the students as well as more interesting descriptive patterns.

Gender. The field of engineering is still perceived to be a male-dominated realm. It was felt to be important, therefore, to first see whether this applied equally to both NES and ESL students. Of the total of 202 survey students, 168 (83%) were male and 34 (17%) were female. The much smaller number of female engineering students, both ESL (n =17, or 18% of the ESL students) and NES (n = 17, or 15% of the NES students), was typical in this engineering faculty, in contrast to the usual undergraduate balance of close to 50% of male and female students for this age group[3]. NES females averaged 19 years and ESL females averaged 23 years old. In terms of specific programs of study, the ratio of female versus male students was generally consistent over most of the engineering programs surveyed here, ranging between 13% and 17% for NES students, and 8% to 17% for ESL students.

A breakdown of performance levels by gender showed generally similar distribution patterns in the means for both NES males (n = 92) and ESL males (n = 76). There was a marked difference, however, between NES females and ESL females with regards to the range of the performance levels. The NES males, NES females and ESL males distributed fairly normally but ESL females scored exclusively into the Pass level. The mean for the 17 NES females was 69%, while the mean for the group of 17 ESL females was 79%. T-tests of the scores compared for NES and ESL females alone produced a significant difference (α = .05, p = .030). However,

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[3] According to statistics available from the university's Office of Research and Statistics, 1995.

these results should be interpreted with caution, given the fact that there were only 17 cases in each group.

The difference in performance level distribution was primarily because the ESL females adhered to the criteria, included the required content elements, and followed organization and format requirements. In marked contrast, however, the ESL females were weaker than their NES counterparts in areas of creativity and language control.

Year of study. This term refers to the student's year of registration when doing the course. More than six times the number of ESL students were taking the Writing Project in their third or higher year compared to NES students. Almost a third of ESL students were doing the Writing Project beyond the normal first or second year of study, and of these, six students were still failing the project.

Number of attempts at the Writing Project. The majority of the students ($n = 178$, or 88% of the whole group) were attempting the Writing Project for the first time. Of the ESL students ($n = 20$) who were attempting the Writing Project a second (or third or even fourth) time, 17 finally passed on this year's attempt. The ratio of ESL to NES students attempting the Writing Project a second or more time was also quite high, with five times as many ESL students in this group of repeaters. In short, the overall difficulty of this project was apparently greater for ESL writers than for NES writers.

3.4.4 Kinds of Writing Selected by NES and ESL Students

The final item on the questionnaire asked the students to indicate the kinds of writing they were doing in their engineering programs. No meaningful test could be applied that would relate performance levels or scores to the selections made by the students of the kinds of writing they reported doing in their engineering programs. Therefore, only descriptive quantitative and qualitative analyses were undertaken.

The kinds of writing students selected (overall and by NES students versus ESL students) are listed in Table 3.2. (Multiple selections were possible).

Table 3.2

Kinds of Writing: Order of Selection Frequency

	Total		NES		ESL	
	n	(%)	n	(%)	n	(%)
Lab reports	186	(97)	101	(96)	85	(99)
Exam. short answers	156	(82)	80	(76)	76	(88)
1-2 sentence answers	129	(68)	69	(66)	60	(70)
Short reports (<10 pp.)	122	(64)	56	(53)	66	(77)
Assignment short answers	107	(56)	52	(50)	55	(64)
Proposals	96	(50)	58	(55)	38	(44)
Short essays (<10 pp.)	52	(27)	18	(17)	34	(40)
Business letters	46	(24)	30	(29)	16	(19)
Long reports (>10 pp.)	30	(16)	10	(10)	20	(23)
Memos	11	(6)	4	(4)	7	(8)
Long essays (>10 pp.)	8	(4)	1	(1)	7	(8)
Exam. long answers (>5 pp.)	7	(4)	4	(4)	3	(4)
Missing cases	11	(5)	4	(4)	7	(8)
Total number possible per Q	191	(100)	105	(100)	86	(100)

Note: *Because of the missing cases (NES students, n = 4; ESL students, n = 7), the totals have been adjusted and the percentages are out of the revised total of possible answers per question.

The selections made by NES and ESL students created a fairly similar ranking overall, but with some notable differences. First, more ESL students selected more kinds of writing than did the NES students. In total, ESL students had an overall selection rate of 5.4 times per student compared to NES students' rate of 4.4 times per student, a difference of 20%. However, the ESL students also under-selected certain kinds of writing in comparison to NES students. The differences in selection patterns between NES and ESL students were analyzed in terms of performance levels, engineering programs and major language groups in order to ascertain whether these variables would show any influence on the students' choices.

Kinds of writing reported within performance levels. In a comparison of percentages of the kinds of writing reported by NES and ESL students within the performance levels, several interesting findings emerged. First of all, the profiles for the NES and ESL students, when viewed by performance levels, were dramatically different. The NES students' selection profile followed a consistent trend for all questions within each of the performance levels. While there were wider ranges for four questions, the overall profiles in the selection pattern by NES students were the same. This suggests a generally similar understanding by NES students of how the kinds of writing were different and whether or not they were actually required by students in engineering.

The selections by ESL students, on the other hand, did not reflect this pattern, nor did ESL students select the kinds of writing consistently as their performance levels declined. NES and ESL students at the Distinction level showed marked differences in their selection patterns for the kinds of writing they reported doing in their engineering programs. Notable differences included the over-selection by ESL Distinction students of *exam long answers, long essays* and *long reports*. Students in the Pass level were similar in their selection of kinds of writing, with the exception of *long reports* and short *essays*, which ESL students picked almost twice as often, and *business letters*, which ESL students selected about half as often as did NES students. ESL students at the Borderline level diverged even more in their selection patterns compared to NES students in the same level. With the exception of *business letters* ESL under-selected (by not selecting at all) many of the more typical kinds of writing. A strong caution must be placed on these findings, however, given the very small number of ESL students at this level who made any selections at all. Fail-level students continued the pattern of inconsistency between NES and ESL students in their selection of kinds of writing. Most NES and ESL students in the Fail level selected kinds of writing at about the same rate. But ESL subjects again over-selected, by quite a wide margin, *short reports, short and long essays, exam short answers,* and *memos*.

Kinds of writing related to engineering programs. Similar to the profile differences related to levels, the charted percentages of answers related to programs of study showed clear differences in the selection of kinds of writing by NES and ESL students despite their similar programs of study. In general, NES students in most engineering programs had a similar sense of the kinds of writing tasks their programs demanded. They also demonstrated some variation according to their specializations, but at this point in their career the differences were not great. In marked contrast, ESL students in the same engineering programs chose kinds of writing more often but less consistently than did NES students, and in their selections did not always resemble the selections made by their NES counterparts. ESL students also tended to over-select kinds of writing that were less likely to form part of their engineering curriculum. For example, far more ESL students said they wrote long reports, or short or long essays than did NES students, even when programs of study were considered individually.

Kinds of writing selected by individual language groups. Since the kinds of writing that were selected by students may have reflected to a degree the experiences specific to their mother tongue background, this was analyzed separately. Other than English, the main language groups were Chinese (combining Cantonese and Mandarin), Tamil, French, Persian, Somali and Urdu. Francophone and Urdu-speaking students seemed to show the most similarity with NES students in terms of their selection of kinds of writing.

3.5 Summary Conclusion to Analysis of Writing Project Evaluation Sheets

An analysis of the mean scores of NES and ESL students on the Writing Project according to the evaluation sheets showed that NES and ESL students were generally comparable in their results. However, analysis of scores by category showed that the ESL students had scored significantly higher in the Organization category than had NES students. ESL students were also stronger on specific questions relating to aspects of formatting and simple inclusion of items in the report but often weaker on those which dealt with conceptual depth. Thus, the apparently similar overall results for NES and ESL students came about because the ESL students had different strategic strengths on some questions which compensated for their weaker scores on other questions requiring conceptual analysis of the problem.

Analyses of the possible relationship between performance levels and data provided by the questionnaire, suggested that the results of the evaluation of the technical reports for NES and ESL students in the Writing Project may have been similar because some of their personal and educational experiences likely mediated their progress. ESL students had generally similar means to their NES counterparts on the Writing Project but achieved this apparent parity for somewhat different reasons. ESL students were more likely to have taken longer time to get to university, delayed doing the Writing Project, and made more frequent (and more unsuccessful) attempts to complete the same requirements for the Writing Project. More stringent adherence to somewhat superficial criteria by ESL students was evident; for example, there was a significant difference between the results for NES and ESL females: ESL female students scored higher because they had more consistently satisfied criteria that dealt with insertion of elements or with style compared with those criteria relating to deeper conceptual analysis. Major language groups showed roughly similar patterns in their category results, and performance levels were not significantly related to working experience or knowledge of other

languages. In terms of high school, a group of ESL students had needed much more time in secondary school, some but not all of it in Canada, in order to complete admission prerequisites. Not all of these were equally successful on their first or second attempts at the Writing Project. Another group of ESL students claimed to have no high school in Canada but had nevertheless taken all their secondary schooling in English. Finally, ESL students' selection of engineering programs did not generally concur with the NES students' choices and their performance levels varied within the same programs.

On the survey question asking students to identify the kinds of writing they were doing in their engineering programs, there was a major difference between the selection patterns by NES and ESL students. Although the ranking of items was generally similar, the selection rates were particularly distinct, mostly because ESL students both over-selected and under-selected kinds of writing in comparison to NES students in the same engineering programs. Differences between NES and ESL students' choices of kind of writing increased notably when selection decisions were reviewed by performance levels, with ESL students markedly inconsistent in their selections compared to NES students at all performance levels but especially at the lower levels.

3.6 Analysis of the Twenty Sample Subset Reports

The purpose of the survey questionnaires and subsequent analysis of demographic data in relation to levels attained on the report writing project was to establish whether variables other than language proficiency alone might account for the scores. The data were also intended to develop a rich description of the student engineering population so as to determine their specific writing skill needs. Table 3.3 compares the results for the sample subset ($n = 20$) with those of the full population ($N = 202$).

Table 3.3
Comparison of Means by Category: All Students (N = 202) vs. Sample Subset Reports (n = 20)

Students	Category: Content %	Organization %	Format %	Language %	Total Means %
Means: All, N = 202					
NES (n = 109)	62	77	84	67	72
ESL (n = 93)	64	81	88	65	70
Means: Subset, n=20					
NES (n=10)	60	74	80	66	70
ESL (n=10)	59	75	88	63	69

Analysis showed that the original Writing Project evaluation sheet scores for the subset reports (n = 20: 10 NES and 10 ESL students) reflected those of the whole population (N = 202) and were therefore representative of the main group of students, as shown in Table 3.3. It was therefore appropriate to submit the sample set of twenty reports to the assessors as representative of the whole population of student reports in the Writing Project.

CHAPTER 4: RESULTS OF THE ASSESSORS' EVALUATIONS OF THE SAMPLE SUBSET REPORTS

The analysis of demographic patterns and engineering report performance levels served three main purposes: first, to discover whether any significant correlations or even strong relationships existed between the background of the student writers and their levels on the engineering reports; second, to make a selection of a sample subset of reports that would approximate the overall profile of the total population who both wrote the report and answered the survey; and third, to ascertain whether the different examples of report writing by native English speaking (NES) students and by English-as-a-Second-Language (ESL) students would elicit similar reactions from professional engineers in both academic and industry settings. This section will outline the results of this evaluation process by the engineer assessors in response to the third research question posed at the end of Chapter 1:

> What are the characteristics of the written work of second language engineering students with respect to the norms of their intended profession?

The following presents the results of the quantitative and qualitative evaluation by the engineer assessors of the twenty reports in the sample subset.

4.1 Analysis of the Assessors' Quantitative Responses

The assessors' scoring of the reports on the appraisal forms was analyzed in a number of different ways, as outlined in the Methodology chapter. The first analysis compared the assessors'

scores on the appraisal forms with the scores the reports had received from the WTS markers for the Writing Project.

4.2 Assessors' Scores on Subset Reports Compared to the Writing Project Results

The assessors' scores were compared to the original Writing Project scores for the twenty students (10 NES and 10 ESL students) in the sample subset. While the correlations between the academic and industry assessors and the original Writing Project scores were similar, the results of paired samples t-tests revealed that the two groups of assessors differed significantly in their scoring of the reports in the subset. The marking by the academic assessors was statistically similar to the marking by the WTS markers who had marked these reports as part of the Writing Project. However, industry assessors scored the reports differently both from the way the academic assessors had and from how the WTS markers had scored. Tests also showed that the correlation between all assessors and the Writing Project markers was clearly much stronger for the NES students than for the ESL students. However, when the assessors' scoring was analyzed separately, it was found that industry assessors' scoring was less in line with the original Writing Project scoring for NES students than was the academic assessors' scoring. When ESL students' reports in the subset were reviewed, it was found that academic assessors followed the patterns of scoring by the Writing Project markers for the ten ESL students while the industry assessors did not. In short, the academic assessors and Writing Project markers had made fairly similar scoring decisions about both NES and ESL students' reports, while the industry assessors differed markedly from both academic assessors and WTS markers in scoring the same NES and ESL reports.

A more detailed analysis of the responses by academic and industry assessors to the subset reports is presented separately for both NES and ESL students.

4.2.1 Assessors' Scores on Appraisal Forms for NES Reports

In considering the scoring patterns generated by assessors for NES reports alone, there were several anomalies which can be noted: Report #20, which originally received a strong Pass level (83%) was only rated a low Pass (68%) by the academic assessors and only a moderate Pass (72%) by the industry assessors. It lost its points fairly evenly across the categories, so there was no one aspect that provoked this more stringent assessment. NES report #191, which received an original Distinction level score of 93% was given only a moderate Pass average score of 77% by the academic assessors, with a more comparable high Pass-level score of 88% by the industry assessors. Report #141, which originally received a failing score of 50%, was awarded a higher Borderline score (61% average) by the academic assessors yet jumped to a Pass of 74% from the industry assessors. Results on the scoring of NES students by assessors are shown in Table 4.1.

Table 4.1

Comparison of Writing Project Results (x/30) with Assessors' Means for NES Students in the Subset (in %)

Rpt. #	Writing Project	Academic Assessors	Industry Assessors
n = 10	Q.1-30 Levels	Q.1-30 Levels	Q.1-30 Levels
020	83 Pass	68 Pass	72 Pass
023	73 Pass	74 Pass	80 Pass
033	70 Pass	68 Pass	71 Pass
054	63 Borderline	61 Borderline	67 Pass
140	70 Pass	61 Borderline	82 Pass
141	50 Fail	61 Borderline	74 Pass
169	57 Fail	59 Fail	73 Pass
184	67 Pass	62 Borderline	68 Pass
191	93 Distinction	77 Pass	88 Pass
217	60 Borderline	63 Borderline	78 Pass
Means	69 Pass	64 Pass	75 Pass

Notes: Since most assessors failed to give any scores for Q.# 25 (on parallelism), this questions was omitted from all calculations. Individual scores were therefore pro-rated for a total out of 30 for each report and then converted to a percentage to maintain consistent comparisons.

Levels: Distinction (90 to 100%), Pass (64-89%),
Borderline (60-63%), Fail (0-59%)

The range for Academic assessors (n = 4) for NES reports was 33% to 90%.

The range for Industry assessors (n = 5) for NES reports was 40% to 97%.

In short, the industry assessors' scoring appeared to be more inconsistent with the scoring by the Writing Project markers. The majority of their scores for NES students' reports were brought into the Pass level, including the originally higher scored Distinction report and lower scored Borderline and Fail reports. It seems the industry assessors did not differentiate between the reports as finely as the academic assessors or the original WTS markers had but instead blended their results into overall Pass-level assessments.

4.2.2 Assessors' Scores on Appraisal Forms for ESL Reports

The average scores given to the ESL reports by the academic assessors were generally lower than the original scores for these reports from the WTS markers, with a few exceptions. The academic assessors gave most ESL students' reports lower scores than these reports had originally received on the Writing Project. Only one ESL report (#90) changed a level upwards and one other stayed in its original Pass level (#137) but gained in percentage points from the academic assessors. Other reports were given comparable or lower levels by the academic assessors than those originally assigned by the WTS markers.

The industry assessors' total mean score for the ESL reports was similar to the mean score they had given the NES reports. However, industry assessors still showed higher individual scores for some ESL reports in comparison to the scoring of these reports by the academic assessors or by the WTS markers. This is particularly noticeable for the two Fail reports (#185 and #226), each of which jumped up two performance levels to a Pass in the industry assessors' scoring. In only one case (#180) did the industry assessors give an ESL report a lower percentage, an assessment shared to an extent by academic assessors. Table 4.2 shows these differences.

Table 4.2

Comparison of Writing Project Results (x/30) with Assessors' Means for ESL Students in the Subset (in %)

Rpt. #	Writing Project	Academic Assessors	Industry Assessors
n = 10	Q.1-30 Level	Q.1-30 Level	Q.1-30 Level
061	73 Pass	69 Pass	78 Pass
090	60 Borderline	75 Pass	78 Pass
106	67 Pass	53 Fail	68 Pass
119	90 Distinction	80 Pass	91 Distinction
137	70 Pass	80 Pass	83 Pass
170	63 Borderline	61 Borderline	69 Pass
180	83 Pass	61 Borderline	74 Pass
185	57 Fail	58 Fail	70 Pass
198	70 Pass	63 Borderline	73 Pass
226	57 Fail	67 Pass	73 Pass
Means:	69 Pass	67 Pass	76 Pass

Notes: Since most assessors failed to give any scores for Q.# 25 (on parallelism), this questions was omitted from all calculations. Individual scores were therefore pro-rated for a total out of 30 for each report and then converted to a percentage to maintain consistent comparisons.

Levels: Distinction (90 to 100%), Pass (64-89%),
Borderline (60-63%), Fail (0-59%)

The range for Academic assessors (n = 4) for ESL reports was 33% to 93%.

The range for Industry assessors (n = 5) for ESL reports was 47% to 93%.

In short, the industry assessors assigned higher scores overall to the ESL reports than had the original WTS markers and generally did not differentiate among the poorer reports (in terms of their original scores) as clearly as did the academic assessors.

4.3 Comparison of Assessors' Scores on Appraisal Forms for the Sample Subset by Category

The judgment on a piece of writing can be based on any number of factors, both holistic and specific. For this reason, the assessors' scoring of the reports was also analyzed by focus area, here represented by each of the four categories: Content, Organization, Format, and Language. The total scores out of 30 points on the

appraisal forms for the sample subset, in fact, did not vary greatly between the two groups of assessors except when broken down by category variables. The correlations between academic and industry assessors for each of the report categories were moderately to strongly positive across NES and ESL student results and followed very similar marking patterns for all categories except Format. However, although they followed roughly the same profile in scoring, the assessors did not score at the same levels. Paired samples t-tests (2-tail) were applied to determine the differences in their scores across the four categories. These showed that the assessors differed significantly in their scoring of the reports when analyzed by category, again with the exception of their agreement in scoring for Format.

4.3.1 Assessors' Evaluation of NES Reports on Appraisal Forms by Category

The original Writing Project mean for NES reports was 69%; the academic assessors' mean score for NES reports was similar at 65% while the industry mean was higher for NES reports at 75%. (Appendix M presents the totals for reports by assessor type).

For NES reports, the criteria questions which generated lower marks in the Content category were those related to the presentation of alternatives, recommendations and original solutions. Those criteria which related to the Organization category referred to the actual organization of these recommendations, especially in an appropriate table, and to the bibliography. In the Format category, improper sub-sectioning and problems with the naming of headings (lack of specificity and irrelevance) generated lower scores from the academic assessors. Finally, in the Language category, the NES reports lost even more points from the academic assessors for questionable grammar and spelling than they had on their original submissions.

4.3.2 Assessors' Evaluation of ESL Reports on Appraisal Forms by Category

The academic assessors' mean for ESL reports was 67%, while the industry assessors' mean for ESL reports rose to 76%, compared to the Writing Project mean of 69% for the same ESL reports.

In all but one instance, ESL reports lost points from the assessors in the Content category for not stating the criteria, for including excessive numbers of alternatives, and for inadequately presenting the recommendations. Under Organization, the ESL reports suffered from a lack of clear statement of purpose, but also (like NES reports) lost points for not having an appropriate table for the data. However, both in the Organization and in the Format categories, ESL reports tended to gain points overall from the assessors. Points lost in the Format category were mostly due to the fact that their headings did not reflect the purpose of the sections, which is more a conceptual than a mechanical element. In terms of the Language category, ESL reports suffered from poor grammar and spelling, and from excessive narrative or rambling style.

In short, NES and ESL students' reports shared similar weaknesses overall, but ESL students' shortcomings in the areas of conceptual and linguistic control were offset somewhat by their better presentation of surface features, with the result that overall means generated for these reports by the assessors were similar.

4.4 Assessors' Responses to the Questions on Professionalism

Six questions concerning the overall professionalism of the report had been added to the original thirty on the appraisal forms provided to the engineer assessors; the additional questions were scored by the assessors in the same way as the first thirty (0, 0.5 or 1.0 point).

The questions on professionalism were analyzed as two distinct types. The first question on hiring was dealt with

separately since it essentially had to do with a judgment regarding the assessor's potential professional action rather than an assessment of focused text-based features of the reports. The other five questions on the professionalism of the report, first generally and then according to the separate categories, were analyzed in order to determine whether there were features of the reports which were acceptable enough to be considered professional by an engineer. Each question was considered per assessor and for the group of assessors as a whole, and by NES compared to ESL students' reports.

4.4.1 Assessors' Responses to the Hiring Question (Q. #31)

The first question on professionalism (Q #31) asked:

> On the basis of this report only, would you hire the writer as a junior engineer?

Differences in the hiring decisions by each type of assessor for NES and ESL students are illustrated in Figure 4.1:

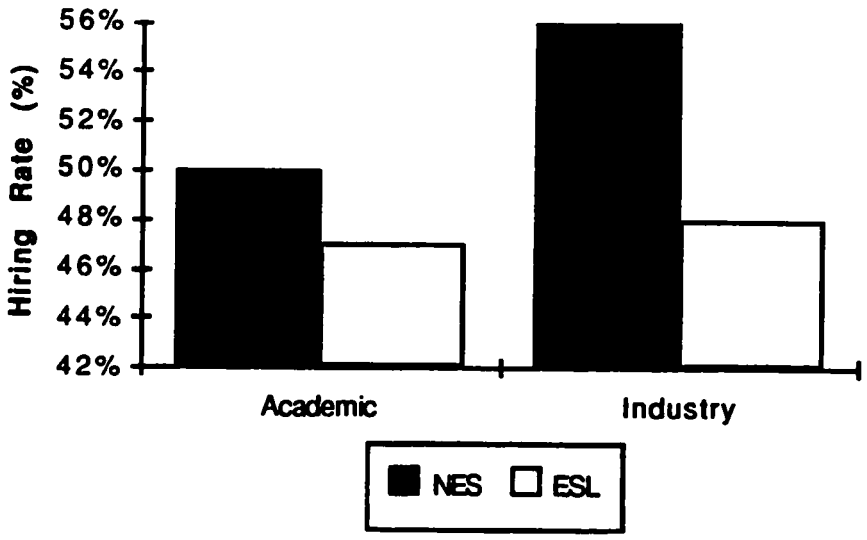

Figure 4.1 Hiring Rates (as Percentage Means) by Type of Assessor (for NES Students vs. ESL Students)

A graphic overview of the total hiring rates (Q #31) presented in Figure 4.1 confirms similar patterns in the potential hiring behaviour of the assessors. Paired samples t-tests (2-tail; $\alpha = .05$) on the hiring rates by academic and industry assessors of the full sample ($n = 20$) and separately for NES and ESL ($n = 10$ each) showed no significant differences between academic and industry assessors. The hiring rates for all report writers were generally low, with the only noticeable difference in hiring pattern shown for NES students (academic assessors would hire 50% and industry assessors would hire 56% of the NES students). ESL students gained lower hiring rates than did NES students, but academic and industry assessors were much closer in these rates. This indicated that despite the high scores some assessors assigned to the reports through their appraisal forms, they were not as willing to transfer that confidence in the reports to an employment decision about the students, not just about ESL students but NES students as well.

The pilot study findings had also shown the assessors had a preference for NES writers over ESL writers. The percentage of NES

students in the pilot study selected by this question was significantly higher at over 63% compared to just under 37% for the ESL group. In that study, however, industry engineers had been much more reluctant to hire the report writers than the academic engineers had been.

4.4.1.a Assessors' Decisions about Hiring NES Writers as Junior Engineers (Q #31)

The decisions about hiring NES writers ($n = 10$) ranged from 17% to 90%. Academic assessors would hire only 50% of the NES students while industry assessors would accept 56% of the NES students. Figure 4.2 illustrates the individual hiring rate decisions of the academic and industry assessors for the NES students only.

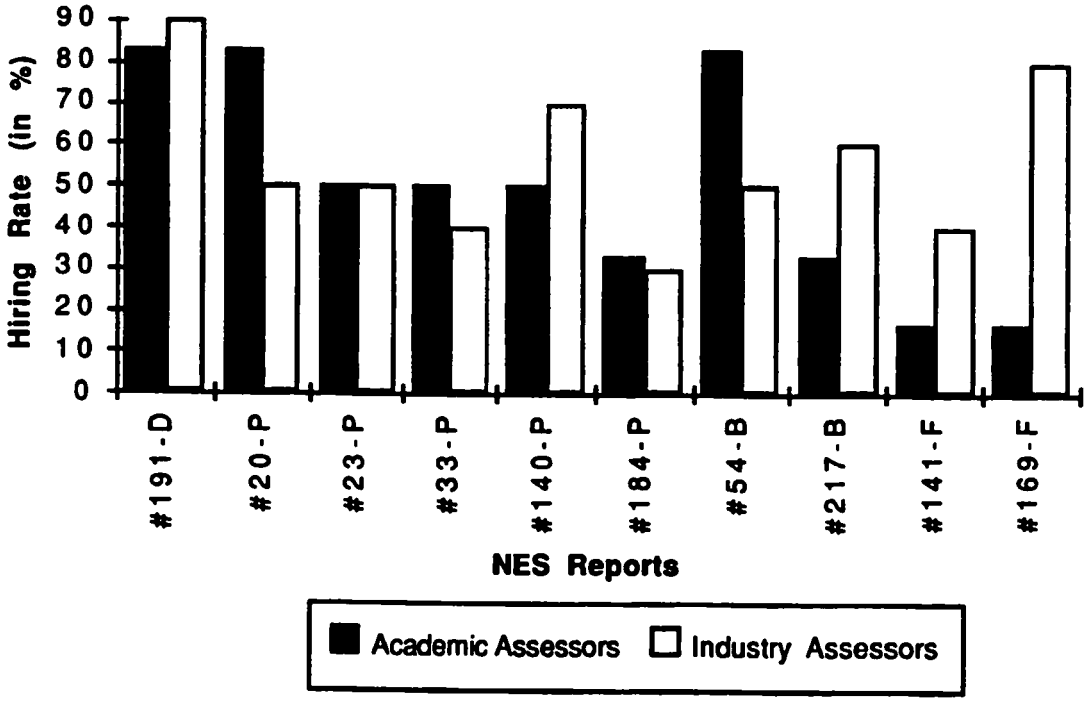

Figure 4.2. Rate of Hiring Decisions (Q #31; in %) for NES Student Reports Only (Academic vs. Industry Assessors). Report numbers are followed by the original Writing Project performance level: D = Distinction, P = Pass, B = Borderline, F = Fail.

A comparison of the scores for the NES reports on the question of hiring showed both similarities and discrepancies (Figure 4.2.). The chart shows that there were considerable differences in the degree of the assessors' readiness to hire in about half of the NES cases.

The NES report with a Distinction level (#191) from the Writing Project gained the highest, although not unanimous, support from all assessors; this choice was a bit less clear-cut for the academics (at 83%) compared to the industry assessors (at 90%).

The acceptability of the four original NES Pass reports varied more among the academic engineers than among the industry engineers. The first report with a Pass level, #20, earned a hiring rate of 83% from the academic assessors but only 50% from the industry assessors. Another Pass-level report, #140, showed a reversal in the decisions by the assessors, with academics' hiring rate at 50% and industry assessors' hiring rate a more accepting 70%. The analysis also indicated that there were discrepancies in decisions made by academic and industry assessors in deciding whether to hire the two NES students who had originally failed the Writing Project. The academics gave each NES Fail writer the same low mean (17%). The industry assessors showed less consistency, however, in that they had low mean rates of 30% to 40% for a number of reports, but these included only one of the NES Fail reports (#141). Report #169 (originally a Fail) averaged significantly higher in acceptability from the industry assessors (with a mean of 80%) compared to academic assessors' decision (with a mean of 17%) for the same report. The two NES reports with an original Borderline result showed more inconsistent decisions: the academic assessors' mean hiring rates was 83% (for #54) and 33% (for #217) compared to the industry assessors' mean hiring rates of 17% and 60% respectively for these same reports.

The hiring rates, i.e., level of acceptability of the writers as potential employees, did not coincide with the assessors' own scoring patterns on the appraisal forms for the first thirty

questions for these same reports. The academic assessors, for example, had been more in line with the original Writing Project scores. In the hiring question, however, the academic assessors showed less agreement with their previous scoring patterns for the same NES students. The industry engineers had averaged higher scores for the first thirty questions overall in comparison to the academic assessors and the WTS markers. However, on the hiring question industry assessors also disagreed with their own earlier scoring decisions on the reports written by NES students and scored them lower for hiring.

4.4.1.b Assessors' Decisions about Hiring ESL Writers as Junior Engineers (Q #31)

The assessors' responses to hiring ESL students ($n = 10$) ranged from 17% to 83%, with means that were lower than for their rates for hiring NES students. As a group, academic assessors would hire 47% of ESL students, while industry assessors would accept 48% of ESL students. The pattern of all hiring rates for the ESL reports is presented in Figure 4.3 below. It shows the overall similarities in the hiring rates; there were only a few ESL reports which produced disagreement between the two groups of assessors. Secondly, the assessors' hiring decisions about ESL students did not agree with their own original scoring patterns for the first thirty questions for the same ESL reports. Furthermore, the hiring rates by the assessors, when compared to performance levels, were inconsistent with the original Writing Project levels for these reports.

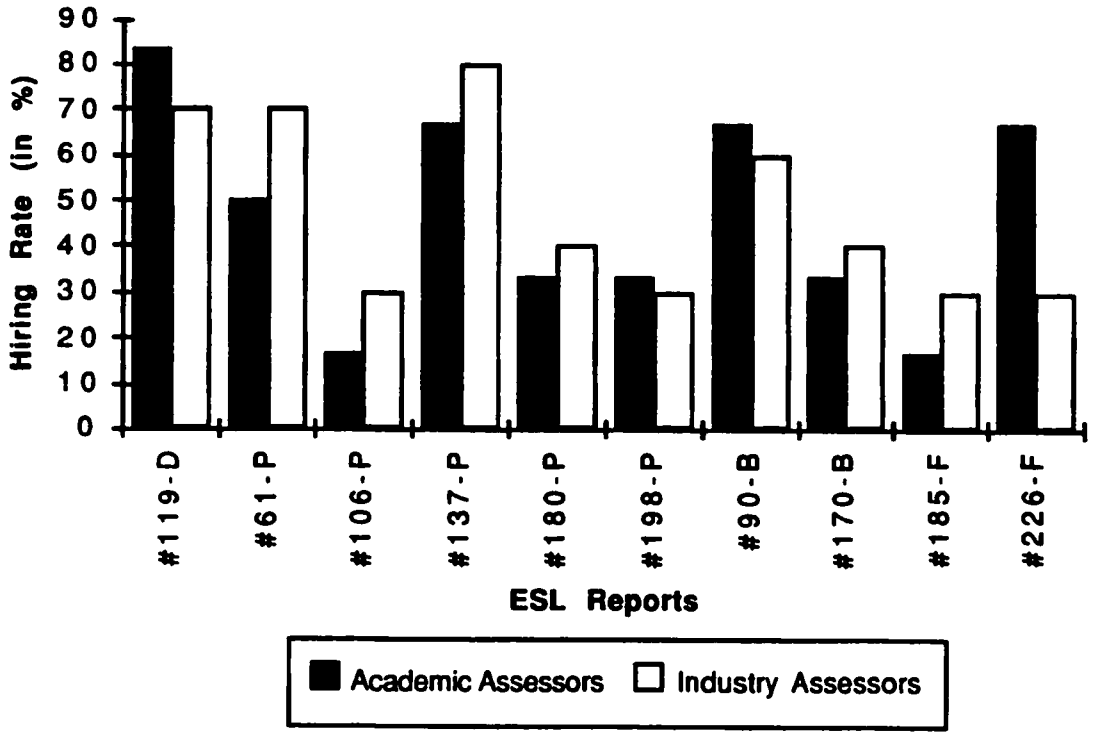

Figure 4.3 Rate of Hiring Decisions (Q #31; in %) for ESL Student Reports Only (Academic vs. Industry Assessors). Report numbers are followed by the original Writing Project performance level: D = Distinction, P = Pass, B = Borderline, F = Fail.

Only four ESL cases which differed in hiring rates from academic and industry assessors warrant a brief review: The Pass-level report #61 showed a higher hiring rate from industry assessors (70%) than from academic assessors (50%). Another Pass-level ESL report (#106), however, showed a similar discrepancy in hiring rate to an original Fail-level report (#185), each of which earned a low rate of 17% from the academic assessors with a moderately higher rate of 30% from the industry assessors. Finally, the other Fail-level report (#226) was markedly preferred by academic assessors (at 67%) compared to its low ranking by industry assessors (at 30%).

In both the NES and ESL sets, the reports with the Distinction level received the highest total ratings for hiring (at 88% and 79% respectively). This at least confirmed the high quality of these two reports as originally scored for the Writing Project. Those reports which had failed and even those which had passed the Writing Project, however, were not always consistently identified by the assessors' answers to the hiring question.

Looking at this question by type of assessor, the industry engineers would hire more readily than the academic engineers but both would prefer NES over ESL students.

In the pilot study undertaken with the previous year's Writing Project reports, NES students ($\underline{n}$ =106) had also been preferred over ESL students ($\underline{n}$ = 51) by a significant margin. In the pilot study only 33% of the NES students would have been hired by the eight assessors and even fewer ESL students at 18%.

4.4.2 Assessors' Responses to the Professionalism Category Questions #32 to #36

The other five questions (#32 to #36) on the professionalism of the report as technical document showed moderate to strong similarities on the scores given by the assessors (see Appendix N). The questions were:

On the basis of this report, would you:

#32 - say this writer has understood the requirements of professional technical writing?

Would you say this report is professional in terms of:

Q #33 - Content?

Q #34 - Organization?

Q #35 - Format?

Q #36 - Language?

Although the means for each question fell within an overall range of from 10 points (academic, question #32) to 13.4 points

(industry, #35) out of 20, the raw scores revealed that only two assessors (academic assessor #6 and industry assessor #7) were more stringent than the others in declaring the reports to be of professional calibre. The means for all twenty reports were lowest for the holistic question (Q #32) about the writer's overall satisfaction of technical writing requirements, as were the means for the question on the use of professional language. The highest means on which both types of assessors agreed were for format (Q. #35).

The relationship of each of the assessors' scores for the five remaining[1] questions in the Professionalism category and their reduced scores for the first thirty questions (pro-rated out of 29) was calculated. The results showed moderate to strong positive correlations in the two sets of assessors' means on the five professionalism questions compared to their means on the first thirty questions for the sample subset of twenty reports.

4.4.2.a Assessors' Responses to the Professionalism Questions by Category

An analysis of the assessors' scores on the professionalism questions #32 to #36 showed that the holistic question on overall professionalism (#32) scored low in proportion to their other scores for the first thirty questions. The academic assessors judged the group of reports to fail holistically (#32), and for the specific questions on Organization (#34) and Language (#36). The academic assessors' overall assessment of professionalism put the twenty reports into the Fail level, in contrast to the industry assessors who scored the reports a low Pass level overall for professionalism. Academic and industry engineers agreed in the profile of their scores but industry engineers were more tolerant in judging each report to be an acceptable technical document.

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[1] The hiring question, #31, was excluded from these calculations.

An analysis of the assessors' per-category scores for the questions on professionalism compared to their overall scores on the reports showed The Format category showed the only agreement in the assessors' scoring decisions. However, there was a significant difference between academic and industry assessors' scores in each of the other three categories. In most cases the difference was greater when the ESL group was considered alone: ESL reports were not as consistently acceptable as the NES reports for the questions of professionalism in these categories.

4.4.3 Results of the Assessors' Judgments About Whether the Report Writers were NES or ESL Students

The instruction sheet for the assessors asked them, once they had completed their evaluation, to guess the mother tongue of each report writer and to state why. The purpose of this question was to find out, first, if the assessor had developed any kind of assumptions about the writer and, secondly, if the reasons given for the guesses were specifically related to how the appraisal form categories had been scored.

Since one academic assessor had declined to answer this question, the number of assessors for this part of the analysis was reduced to eight: three academic and five industry assessors.

Both types of assessors guessed wrong (and inconsistently) for both NES and ESL groups; that is, no assessor guessed correctly all twenty reports of the sample subset, nor was any assessor accurate for all ten of each group of NES or ESL students. There was no significant difference between the two groups of assessors for this question. (See results per report and per assessor in Appendix O for their judgments on whether the report writer was an NES or ESL student, and Appendix P for a breakdown of these decisions by assessor type.) The pattern of correct judgments about whether the student was an NES or ESL student was analyzed. The selection

patterns varied by performance levels for the two groups of assessors, as shown in Table 4.3.

Table 4.3
Number of Correct Guesses about Whether Reports were by NES or ESL Students, by Performance Level and by Type of Assessor (Academic and Industry)

Students	Writing Project Level	No. Correct Max.	No. Correct Academic	Accuracy Rate (%)	No. Correct Max.	No. Correct Industry	Accuracy Rate (%)
NES	Distinction	3	3	100	5	5	100
	Pass	15	6	40	25	16	64
	Borderline	5	5	100	10	7	70
	Fail	6	4	67	10	9	90
Totals	NES Students	29	18/29	62%	50	37/50	74%
ESL	Distinction	3	0	0	5	2	40
	Pass	15	12	80	25	16	64
	Borderline	6	3	50	10	5	60
	Fail	6	4	67	9	7	78
Totals	ESL Students	30	19/30	63%	50	30/49	60%

Academic Assessors, $n = 3$ (except for Report #54 , where $n = 2$)

Industry Assessors, $n = 5$ (except for Report #185, where $n = 4$)

The academic assessors' accuracy rates for guessing the mother tongues of both NES and ESL students were the same at 62% and 63% respectively. Industry assessors differed somewhat in their accuracy: 74% for NES students and 60% for ESL students. The lower the percentage for an ESL report, the more likely the assessors felt it resembled a product written by an NES student. Only the report written by the NES student with an original Distinction result on the Writing Project received unanimous agreement from all assessors that it had indeed been written by an NES student.

4.4.4 Comparison of the Judgments about Report Writers being NES or ESL Students and the Hiring Decisions by Assessors

In order to determine if the ability to guess the mother tongue of the report writer was related to whether the assessors would

have hired the same student, a comparison was made of these decisions. The results for NES students are shown in Figure 4.4.

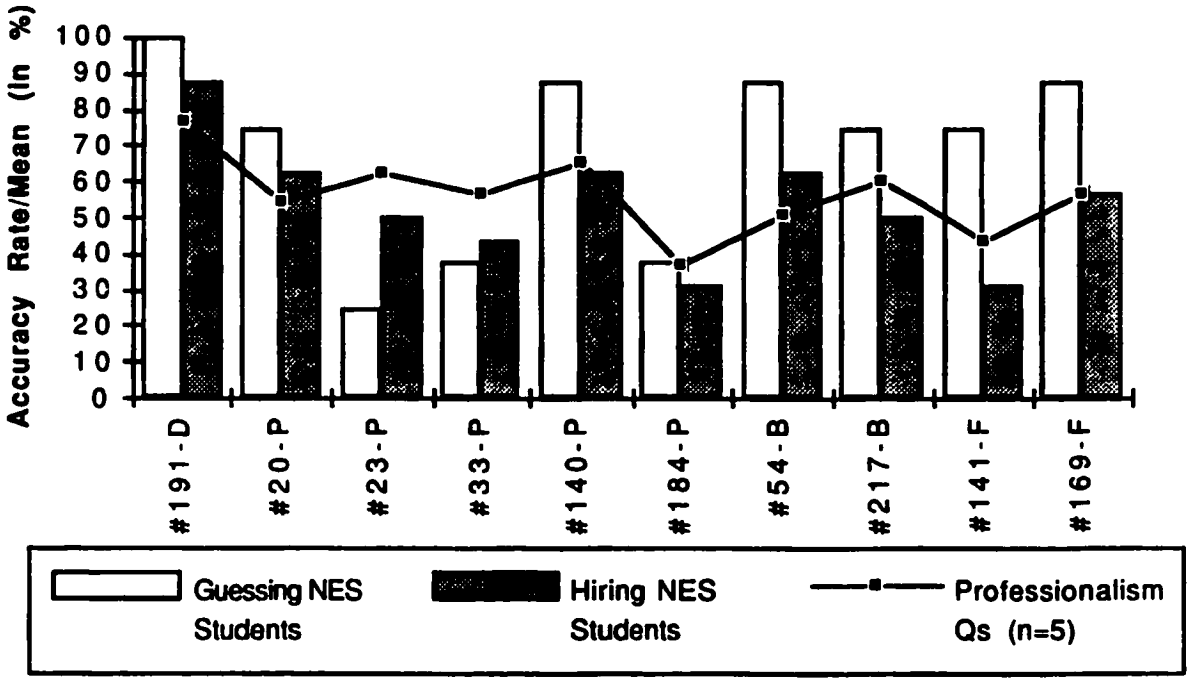

Figure 4.4 Comparison of Accuracy in Guessing NES Students vs. Decisions about Hiring NES Students (All Assessors), in %, per Report. The means (as %) from all assessors for the five main professionalism questions (#32-#26) are superimposed merely to indicate assessment profiles and should not be seen to imply statistically meaningful relationships.

Note: Original performance levels are indicated behind the report numbers:

D = Distinction, P = Pass, B = Borderline, F = Fail

A comparison of the results of guessing NES students and the hiring decision about NES students showed no obvious relationship between being an NES student, achieving a specific performance level in the Writing Project and being considered for employment. There did seem to be an indication that hiring decisions were based on the assessors' overall sense of the professionalism evident in the NES reports.

A similar comparison of the results of guessing and hiring ESL report writers was made, as shown in Figure 4.5.

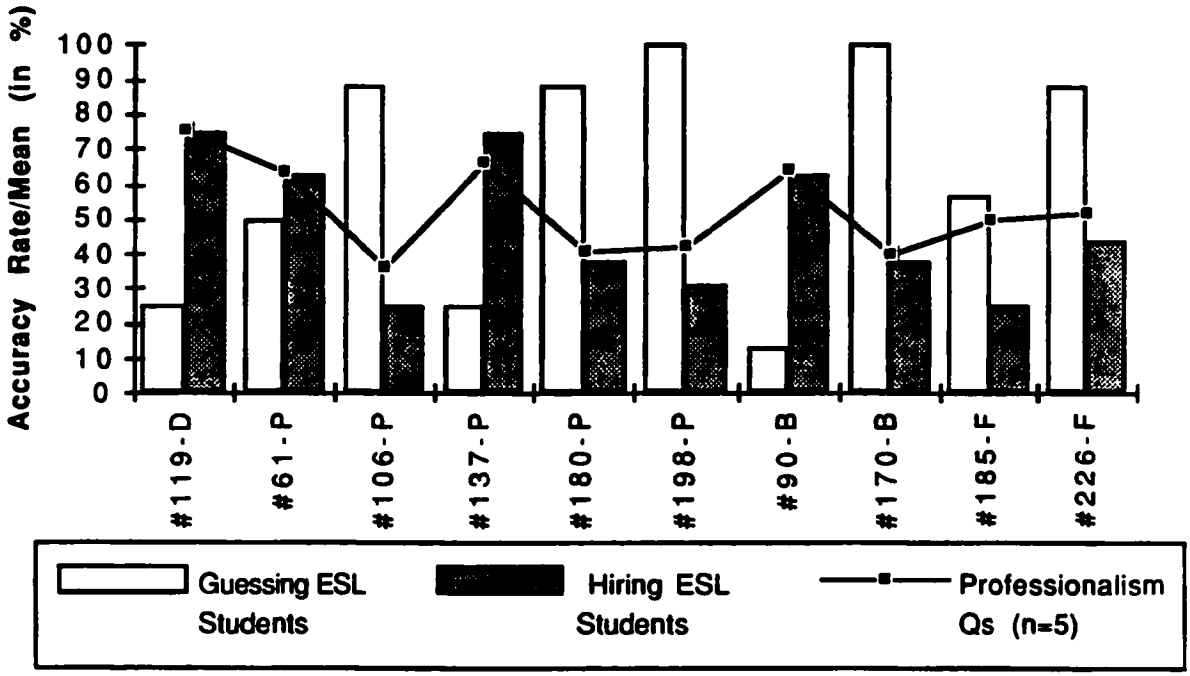

Figure 4.5 Comparison of Accuracy in Guessing ESL Students vs. Decisions about Hiring ESL Students (All Assessors), in %, per Report. The means (as %) from all assessors for the five main professionalism questions (#32-#26) are superimposed merely to indicate assessment profiles and should not be seen to imply statistically meaningful relationships.
Note: Original performance levels are indicated behind the report numbers:
D = Distinction, P = Pass, B = Borderline, F = Fail

In evaluating the results for guessing and hiring ESL students, it should be remembered that low accuracy rates in guessing indicate that the assessors thought the report writer was a native English speaker. Despite its high NES student-like rating, the ESL report with Distinction (#119, a 21-year-old Cantonese speaker from Hong Kong who had spent just over four years in Canada), did not stand out as being the most likely to be hired. Instead, its guessed/hired pattern resembled that of a Pass-level report, #137, whose original Writing Project score was a modest 70%. However, this same report, #137, was the only one given a Distinction-level

rating by the industry assessors (academic assessors having only given it a mid-level Pass rating). The writer of report #137 was a 20-year-old native speaker of Setswana from the country of Botswana which uses English as a second official language. He had been in Canada for two years. The ESL report with the highest rate for being mistaken for one written by an NES student, #90, was an original Borderline, and it also gained a high hiring rate. This report writer was a 19-year-old native speaker of Urdu who had arrived four years earlier from Pakistan, another country where English has semi-official status. The rest of the ESL report writers were more accurately guessed to be ESL students and less likely to be hired. Again, hiring decisions about ESL students seemed to profile in similar ways to the judgments about the professionalism of their reports. (Note that this comparison of decision profiles between hiring and judgments about professionalism does not imply a statistically meaningful relationship.)

4.5 Conclusion of Analysis of Assessors' Quantitative Responses

The results of the engineer assessors' scores on the appraisal forms for the twenty reports in the sample subset provided a first sense of how acceptable the assessors found these reports to be within the context of specific criteria. In general, academic assessors had the same scoring patterns as had the markers for the Writing Project. Industry assessors, on the other hand, deviated from these patterns and tended to score the reports more generously. In both cases, the ESL reports were judged more favourably, on the whole, than were NES reports. The higher scores for ESL, especially by industry assessors, did not transfer to the hiring decision about the report writers. Both NES and ESL report writers gained only low acceptance rates for hiring, but NES students were still preferred over ESL students by both types of assessors, a finding which was occasionally at odds with the assessors' scoring patterns for NES and ESL reports.

Finally, analysis of the assessors' decisions about the mother tongue of the report writers showed a pattern in their decision that related to their individual scoring patterns on the appraisal forms. In a number of cases, the assessors guessed that the reports to which they had given lower scores had been written by ESL writers and those with higher scores had been written by NES writers. Up to half or more of the lowest ranking reports for each assessor were deemed to be ESL in origin, whether or not they were in fact ESL. This pattern held for almost half of the assessors, although for some more consistently than others. Even ESL reports at the highest scoring levels were guessed as having been written by ESL students, which meant the reports passed as having NES-like characteristics in writing, yet still somehow revealed their ESL origins to the assessors.

4.6 Analysis of Assessors' Comments

A qualitative analysis of the assessors' comments on the appraisal forms and written on the reports themselves was performed. The description of the results of this analysis is presented in sections 4.7 to 4.12.

4.7 Assessors' Comments About NES and ESL Subset Reports Written on Appraisal Forms

The assessors had been asked to jot down any comments in the boxes provided on the appraisal forms while they were in the process of evaluating the reports. Academic assessors ($n = 4$) and industry assessors ($n = 5$) differed in the number of comments they made on the appraisal forms about the reports (see section 4.7.1, Number of Assessors' Comments on Appraisal Forms, for a description of the numerical breakdown).

One note is in order: It was hard to categorize some of the comments because the assessors did not always maintain the focus of the criteria within the categories when they wrote in the boxes provided on the appraisal forms. However, the decision was made not to move any comments into category boxes that seemed more relevant since this could potentially distort the interpretation of the assessors' views of the criteria. Instead, even apparently unrelated responses were left in the category comment boxes they had been written in but were noted as possible anomalies.

4.7.1 Number of Assessors' Comments on Appraisal Forms

The assessors wrote a total of 459 comments in the boxes provided for each category on the appraisal forms. Academic assessors only wrote 10% of these (see details in Appendix Q). The difference in the number of comments made was skewed by the fact that two of the academic assessors chose not to write any comments on the appraisal forms, whereas almost all of the

industry assessors did so on a regular basis. The number of written comments varied over the 700 comment boxes provided (i.e., 140 appraisal forms, or five categories on each of the 20 reports for each of seven assessors). The ratio of positive to negative comments also varied per assessor type. Academic engineers' positive comments comprised only 15% of the total comments they made. The number of industry engineers' positive comments, on the other hand, comprised a more balanced 43% of the total comments they made. While a negative focus on Content predominated for academic assessors on both NES and ESL reports, industry assessors spread their comments more evenly over all categories except for Format. The ESL reports received most of the negative comments from the industry assessors in the categories of Content, overall Professionalism and, especially, Language.

Assessors did not always agree in their evaluation of the reports, at least in terms of their comments on the appraisal forms. The industry assessors agreed on the NES report #191 with a Distinction level in the number of positive comments (11 positive vs. 2 negative comments) and on the ESL report with Distinction #119 (9 positive vs. 2 negative). In contrast, academic assessors made almost no comments on the reports with Distinction. There were few Pass reports for which there was clear agreement; others generated roughly equal numbers of positive and negative comments. (Examples of specific differences are noted within the summary of comments for each category.) The industry assessors even found something constructive to say about the Fail and Borderline reports which also followed the pattern of having a broadly equal number of positive and negative comments, regardless of their original low scores. Except in the case of Distinction reports, the number or type of comments made by the assessors did not seem to be influenced by the original scores or performance levels of the sample subset of twenty reports.

The breakdown of comments per appraisal form category is outlined below.

4.8 Assessors' Comments Written on the Appraisal Forms by Category

Since the industry assessors wrote far more comments for each of the categories, there was potentially more insight available for analysis from this group. The result for each report in the sample subset revealed very few instances of agreement among the industry assessors regarding the quality of a report for a particular category. Similarly, there was no consistent correlation between the original scores of the reports and the type of comments about them in terms of the categories.

The comments made on the appraisal forms were reviewed according to each type of assessor's response to the category focus areas (Content[2], Organization, Language, Format, and Professionalism) for both NES and ESL student groups, as well as by type (positive, negative or mixed responses by the assessors). All comments are reproduced verbatim; ambiguous comments were not considered.

4.8.1 Assessors' Comments Written on Appraisal Forms about Content

4.8.1.a Comments on Content in NES Reports

Similarities in the focuses in the assessors' comments on content are considered first. Some of the comments on the presentation of content in the NES reports were positive responses but most assessors were critical of the student's reports on a number of key criteria. First, both types of assessors generated the most number of comments with regards to the NES students' overall understanding of the infestation of zebra mussels in the Great Lakes and made reference to the quality of their solution to that problem.

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[2] The students' task on the Writing Project had been to write a technical report that discussed alternatives and recommended a solution to the problem of the infestation of zebra mussels in the Great Lakes.

1.[3] The original solution of the student does not make sense.
2. This report does not indicate any grasp of the scope of the problem.

Particular criticism was aimed at the NES students' not distinguishing clearly enough between alternatives and recommendations in dealing with the infestation problem. Another frequent concern was the student's understanding of the assigned task. The following example includes both issues:

3. Although generally well presented, the recommendations are rather vague; the three 'most popular' methods are chosen, but all alternatives are considered sound. The purpose of the report has not been achieved.

Assessors consistently reiterated that adherence to the purpose of a report was a requirement for good engineering writing. Poorly focused writing was also seen as a fundamental flaw in these technical reports.

Insufficient depth of analysis was another frequent criticism:

4. This report is naive. Although an original solution is proposed it is not well thought out.
5. The paper shows a surface understanding of the problem.
6. The student shows some understanding of the complexity of the problem in his/her analysis. However, some obvious solutions, such as using deep water pipes, are not discussed. One gets the feeling that the analysis is not complete.

Assessors signaled the inconsistency between some reports' quality of content and their presentation or organization:

7. Gen: doesn't flow well. The writer does make a strong positive statement about his/her recommendations, which is good.

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[3] The longer quotations are numbered separately within the discussion of each category solely for ease of reference.

8. The student seems to be able to put ideas together and understands the problem, but he/she doesn't follow conventional form. The command of the language seems adequate but the report writing skills need practise.

This academic assessor here revealed an expectation that mastering so-called conventional form was an essential technical writing skill. In some cases, language and "flow"[4] (a term assessors used often) also seemed to affect the industry assessors' view of content in NES reports:

9. weak; GENERAL: Does not flow well.

Redundancy was also criticized ("too much repetition of the same information in varying degrees of detail"), as was excessive brevity ("Too brief; not developed enough"; "Too much in point form!").

Anomalies in the evaluation of content in NES reports were noted:

Not all assessors' viewpoints agreed; one report, for example, earned this praise:

10. Good; flows well, covers all requirements.

But of this same report, another assessor said:

11. The report is naïve. Although an original solution is proposed it is not well thought out.

For another report, academic assessors wrote:

12. Very good.
13. One of the better reports with regards to content
14. Content is good; not well organized.

Yet, for the same report referred to in the three comments above, another assessor said:

15. This student has no concept of the scale of the problem and no idea what is expensive or inexpensive.

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[4] Quotation marks are used to indicate that these were the exact terms used by the assessors in their comments on the appraisal forms.

One report whose original score was Borderline confounded the assessors' judgments, specifically in terms of content and language as these contradictory comments about it showed:

16. OK, but poorly written
17. Gen: Poor; does not flow
18. Well written but not enough emphasis on recommendations

In sum, in terms of the management of content by NES writers, academic and industry assessors alike shared their concern for a number of key deficiencies, especially about the students' not having a proper grasp of the problem and being unable to distinguish between alternative and recommended solutions. However, the assessors' judgment as to which particular NES reports demonstrated weaknesses in the Content category were often inconsistent and even contradictory. Furthermore, assessment of content was frequently mixed with concerns about language weakness or poor organization, or in their terms, "presentation".

4.8.1.b Comments on Content in ESL Reports

In assessing the content of the ESL reports, the academic assessors were concerned about generally the same aspects as they were in the NES reports, but an overlay of additional criticism was directed towards poor language use. Not one of the five ESL reports in the sample subset which had been given an original score of Pass received a single comment by the academic assessors. Only the five ESL reports with Borderline, Fail and Distinction results provoked a response. (The academic assessors' comments on the appraisal forms for NES reports did not show this pattern of specific interest.)

About half of the assessors' responses to the non-Pass-level reports focused on the ESL student's grasp of the problem and the quality of the recommendations they offered. While there were positive comments, most were negative, as these examples show:

19. This report is very professional. The student has also researched additional sources.

20. Weak finish! No evidence of understanding the problem and how the problem might be solved by the recommendation.
21. The student hasn't understood the difference between prevention of future problems and the solution of this problem.
22. The student has written a good report, but the depth of analysis is very shallow. The report reads like an assignment where the student is looking for the right answer, when no answer is right.
23. Many of the ideas are not well thought out. There are many cases of jumping to the wrong conclusion.

Lack of balance in the selection and quantity of data also remained a weak area in ESL reports, especially according to the industry assessors:

24. Fair; summary gives background and problems, repeats background
25. Inconsistent depth of discussion. Some alternatives are explained in detail, others are merely mentioned.

There were frequent negative comments on the use of language with regards to its effect on the presentation of content:

26. There are glimmers of knowledge, but they are obscured by the poor presentation (primarily language).
27. Strong start: readable, mostly flashy presentation (good editor?)

One could ask here (#27) whether this assessor suspected this was not the student's own work or ability; indeed, plagiarism was a frequently repeated suspicion, one that was far more often aimed at ESL than NES reports.

Even when focusing positively on content, industry assessors commented on the language produced in NES reports, but when reading ESL reports they did so to an even greater degree, as these examples show:

28. Ideas (content) are sometimes clouded by awkward language.
29. Good overall structure for the report; adequate research, but the English is very bad. All the main parts of the report are included but the poor English makes it difficult to read.
30. The student appears to understand the underlying topic but the expression of this understanding is masked by poor control of language.

At times, the industry assessors questioned an ESL writer's ability to read, a criticism which was repeated later for other categories:

31. The student doesn't seem to have understood the topic at more than a superficial level. Errors of fact imply that the student didn't read carefully.
32. The student has confused the solution to problem with the prevention of future similar problems. This indicates a lack of thinking, regardless of language issues. It also appears that the student hasn't read the sources carefully since he/she jumps to erroneous conclusions.

Other times, content in an ESL report was approved but not its organization:

33. The content is good; suffers a bit from poor 'assembly'.

Anomalies in the evaluation of content in ESL reports were noted:

As was the case for NES reports, not all industry assessors viewed the same ESL reports the same way. For example, the following two comments were about the ESL report in the subset which had received an original score of Distinction from the Writing Project markers:

34. Very interesting! The writer has followed the evaluation guideline to the letter (the only one to do so). All in all, a good basic report.

35. Although all of the components of a report are there, there is a lack of depth of understanding. Prevention, in this case, is closing the barn door after the horse has gone.

At least one assessor agreed with the original Writing Project score of Distinction, but called it only a "good basic report", while another seemed to worry about the deeper-level quality of the student's understanding of the problem.

There were both shared and divergent views expressed by academic and industry assessors' views about NES and ESL reports. On the positive side with regards to the Content category, academic assessors appreciated some reports for (in their terms) "originality", "readability", "knowledge", and "good start" and conclusion. In their negative comments regarding content, the academics cited poor comprehension, redundancy, lack of scope or limitations in content, excessive information, unpolished style ("too draft-like"), and the fact that content was often marred by the poor use of language, format or organization. The academic assessors found similar weaknesses in content control in NES and ESL reports (mostly regarding comprehension of purpose and distinction between alternatives and recommendations) but they emphasized the lack of readability and poor style more often in ESL reports than they did in NES reports. ESL reports tended to generate more criticism from the academic assessors about linguistic interference in the presentation of content. This pattern of response focus was repeated but also intensified in the case of the industry assessors

The industry assessors' responses to the content in ESL reports were very similar to those they made to the content in NES reports. Industry assessors praised both NES and ESL reports for their originality but more often were critical of the insufficient distinction the students had made between alternatives and recommendations, and emphasized the students' poor grasp of both the problem and the engineering task. However, one particularly different overlay on comments on ESL writing was the focus on language use by the ESL writers, including general syntactic and

lexical control. In addition, industry assessors, more often than academic assessors, questioned the level of reading comprehension of the ESL report writers.

4.8.2 Assessors' Comments Written on Appraisal Forms about Organization

4.8.2.a Comments on Organization in NES Reports

The Organization category did not provoke many comments by the academic assessors on NES reports, but all of them were negative. Most of the criticism focused on illogical order of the sub-sections ("Too much concl./recomm. before supporting info.") and the quality of the table ("Table seems to duplicate point form info. given on page").

Industry assessor's comments on organization in NES reports were more numerous and much more diverse. Some positive comments ("logical"[5], "orderly") were provided by industry assessors, but most of their responses were negative ("random assembly") or mixed, as this longer example shows:

1. The organization of the report is very professional. However, it lacks reference. The report is well organized but the content fitted into the template is shallow.

Other industry assessors chastised NES students for not following the instructions provided.

In brief, industry assessors focused on the logical order of sections ("covers everything in an 'orderly' manner") and questioned whether the ideas in NES reports were presented logically according to their own (the assessors') frames of reference. Good management of organization was seen to aid and reflect control of content.

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[5] All terms in quotation marks cite the exact words used by the assessors, as do the longer numbered quotations

4.8.2.b Comments on Organization in ESL Reports

In their consideration of the organization of reports written by ESL students, academic assessors only cited ESL reports for being more deficient in mechanical or editing aspects, for not referring to the table, or for ending "a bit abruptly".

Industry assessors also picked up the aspect of carelessness or "poor assembly" as well as deficiencies in the bibliographies of ESL reports. But more emphasis was placed by industry assessors on the main weakness in some ESL reports, namely that adequate organization could not mask deficiencies in content:

2. All the elements of a good report are here, but the shallowness of some of the discussion shows a lack of experience.

Industry assessors expressed concern about the conceptual confusion that arose from inadequate organization. For example, industry assessors referred to ESL students' difficulties in understanding how to organize the alternatives:

3. The student has listed all alternatives together, even though they apply to different issues. Some are preventative measures, whereas others are operational measures.

They extended this criticism with specific references to the need for the writer to master both organization and content for the sake of the reader:

4. Fair; doesn't seem to grasp the importance of 'first impression'. No clearly stated purpose weakens the report.
5. On the surface, this report look organized, but weak content loses the reader.

Several times, industry assessors raised the standard of the potential reader to that of "client", a term not used by the academic assessors:

6. This report is well-organized and could be presented to a client (if language errors were corrected).

The industry assessors also made far more comments about the specific items they wanted to see in the reports (i.e., recommendations, conclusions, summary, statement of purpose, background) and the order they wanted to see them in, as summarized by this statement: "The order of the sections is not normal." In particular, the lack of an executive summary in the reports was noted several times, an element that the academic assessors did not mention. Several industry assessors also criticized the use (or lack) of a properly organized table:

7. The only thing lacking is the use of a table that outlines all the alternatives. Without a table or point form list the reader is unsure whether the report is comprehensive.

Here the assessor is suggesting that it is common organizational practice in engineering writing to present a visual or graphic summary of the text information as a measure of completeness. This was not mentioned by academic assessors.

Only one anomaly in judgment about a particular report was noted in terms of its organization: "not good", compared to "Well organized, except that a statement of purpose is missing."

The academic and industry assessors agreed about what constituted appropriate organization of a technical report ("logical order"), but industry assessors were much more specific, citing the need for conceptual and organizational balance, for required sub-sections (especially an executive summary) and a focus on the possible audience for the document. In brief, organization was recognized as serving conceptual and focusing functions in a technical report.

When the reports were adequately organized, the commentary was general ("OK", "good", "balanced details", "reasonable structure"). When the reports were poorly organized in some way, however, the

assessors, industry ones in particular, became much more specific in expressing what was lacking. A very strong sense of what was proper or acceptable with regards to sub-sections was expressed on many appraisal forms. For example, both academic and industry assessors were dismayed at the "poor logic" of a report, focusing particularly on the "improper order of the sub-sections". Industry assessors, especially, insisted on logically ordered sub-sections as well as the need for specificity in their nomenclature and for clarity in their focus. Other concerns about organization centred on inadequate graphics and poor or improperly presented references, citations or bibliography, which were not specifically organization-related matters yet still grouped under this heading by the assessors.

4.8.3 Assessors' Comments Written on Appraisal Forms about Format

4.8.3.a Comments on Format in NES Reports

There was limited attention paid to format by the academic assessors on NES reports. Industry assessors, for their part, did not always distinguish clearly between organizational elements and the mechanics of putting together a properly formatted report. Concerns were expressed about the sub-sectioning of a report and its effect on style (a term used often but not defined by the assessors):

1. No sub-sections, but not a problem--overall, report is short & doesn't really require sub-sections
2. The style of the report is somewhat confused. It starts with a letter, which is good, but it is missing a section.

And nomenclature was at times important but at other times dismissed:

3. Notes--bibliography--what's the difference?

Similar to the comments made in other category comment boxes, industry assessors who wrote about the formatting of NES

reports primarily related it to sequencing or lack of components and to aspects of carelessness.

Finally, one NES report merited this positive comment (written in the Format category comment box):

> 4. The report is well organized. A manager could look at the summary and recommendations and understand the essence of the report. This is an important aspect of professional writing.

This comment put into a nutshell what many advocates of good report writing recommend, namely that a well-organized professional report is one whose constituent parts can be accessed easily by various types of readers, including one with a non-technical purpose.

4.8.3.b Comments on Format in ESL Reports

There were no comments on the format of ESL reports written by the academic assessors. Industry assessors, however, did note numerous deficiencies in ESL reports in the comment box provided for format, particularly for illogical sequencing as well as missing or unnumbered sub-sections (seen as "carelessness in formatting" or as the result of mechanical or technical difficulties: "somewhat sloppy, maybe problem with word processor"). Carelessness, as evidenced by poor formatting and other surface aspects of presentation, was considered to be highly unprofessional and not at all tolerated.

The main concerns raised were about the reliance of content on format for effectiveness, especially in the selection of appropriate titles for the sub-sections:

> 5. The first two sections would normally be called Abstract and Introduction rather than Summary and Recommendations.

This industry assessor here demonstrates a firm notion of the standard practice for formatting and for nomenclature in engineering writing. A frequently expressed concern, both within the Format category proper and within other categories, was about inappropriate labeling.

Finally, one assessor focused on a common problem shown in the following example:

6. A one-sentence introduction is of no use. It should have been combined with the next section. The student is following form but not thinking about why.

This last comment highlights a shared concern among assessors that students were "following form" without understanding the underlying principles of organization and format of a technical document whose purpose was to convey ideas effectively and efficiently. Assessors expected format to serve the purposes of content rather than be produced by rote.

4.8.4 Assessors' Comments Written on Appraisal Forms about Language

Even more than content, language on the reports generated the most comments from the assessors. Both general and extremely specific remarks were made by both types of assessors.

4.8.4.a Comments on Language in NES Reports

Only three NES reports provoked responses by the academic assessors about their use of language:

1. Very clear opening!
2. Readable
3. Sloppy (but inconsistent)

Industry assessors praised NES report language:

4. Very good
5. Well written, concise but comprehensive

but more often criticized it:

6. Bad English; needs lots of work

A large number of comments about language use listed quite specific attributes:

7. Sentences are awkward, making the report difficult to read. Simpler sentence structure & simple wording would make the report easier to follow.

Industry assessors were especially critical about the sophistication of both the language used and the level of understanding it conveyed:

8. Some of the language seemed childish. The arguments were also shallow.

Industry assessors also seemed to share a commonly-held view that engineering and report writing require objectivity in language, as these two examples show:

9. sometimes lapses into narrative style and use of personal pronouns
10. Language gets a bit fluffy in places

Other comments focused on very particular mechanical errors as deficiencies that undermined the professionalism of a report:

11. The language is simplistic and does not give the impression of professionalism. Simple language gives one the impression that not much thought has gone into the analysis.
12. Running a spell checker on a finished product shows a level of care inherent in professionalism.

Carelessness and lack of sophistication (inappropriacy) in language use were the industry assessors' main concerns with NES reports and may account for some of their lower scores on reports which had originally scored higher on the Writing Project.

Anomalies in the evaluation of language in NES reports were noted:

There were few examples of disagreement about the language in NES reports. Indeed, only one NES report received comments which revealed an anomaly in the assessors' judgment:

13. The glaring spelling mistakes in a title and other similar mistakes detract from an otherwise excellent report.
14. Occasional grammatical errors, but generally well written. Sentences are often too short and abrupt.

These two comments were written about the only NES report in the sample subset with an original SERWP result of Distinction, a level not subsequently assigned it by the assessors, perhaps partly for reasons of language.

4.8.4.b Comments on Language in ESL Reports

Only two academic assessors commented (negatively) on the language of ESL reports on the appraisal forms, despite a lot of criticism expressed through the actual scores and on the reports themselves, namely: "Too brief!" and "The language in this report is unacceptable."

Industry assessors, on the other hand, were much expansive in their evaluation of the language produced by ESL students. Generally, however, industry assessors responded more frequently, more critically and more specifically to errors in the language used in ESL reports than to the language in NES reports: "Very poor grammar; difficult to read"; "English is quite poor." were typical comments. Other than numerous general statements, the industry assessors more often than not specified the language errors they found troublesome:

15. Poor control of verbs and prepositions. The student has trouble with basic grammar.
16. The student frequently uses the wrong tense for verbs and drops articles and prepositions. The ideas expressed are masked by the poor language.

17. The student has a tendency to make sweeping statements or use broad connecting phrases that are detrimental to the argument.

Here the importance of using accurate language to ensure the effective presentation of content is stressed. The last assessor (comment #17) also appears to have a sense of how rhetorical features in a report need to be well controlled.

Even when industry assessors commented on carelessness in language use in ESL reports, it was with a sense of language proficiency:

18. There are minor errors in grammar that seem to be the result of not taking enough care, rather than a lack of skill.

ESL reports, more than NES reports, generated the most suspicion about plagiarism, usually based on language use:

19. Excellent writing at times, but the Background section looks remarkably similar to that of at least 1 other report, leading to suspicion of plagiarism.
20. Some sections are obviously plagiarized; the grammar is clearly not that of the author.

An underlying implication here seems to be that the ESL student author had demonstrated his/her own poor grammar elsewhere in the report, which was then compared unfavourably to the grammar in better written sections.

Finally, as in so many other comments, the assessors stated clearly their belief that the degree of mastery of the category being evaluated, in this case, language, would have an impact on the professionalism of the report:

21. The minor grammar errors make one believe that the writer is not a native speaker. This can be excused if the report is professional enough, but the report needs to be better to compensate.

The ESL report with the highest original score of Distinction as well as a fairly high level of acceptance through the assessors' scoring, is noted for its language. The comments suggest that language control was at least a prerequisite for a positive evaluation, whatever other positive attributes may have been present:

23. Good overall; some re-writing needed.
24. The student has good control of language.

Anomalies in the evaluation of language in ESL reports were noted as follows:

The following two comments refer to the same report, indicating a striking contradiction in the assessment of ESL language use:

25. lang. in report a plus
26. BAD!

In summary, the few positive comments assessors made about language were fairly general: "good", "OK", "good readability", "concise but comprehensible", or "generally well written". Negative comments on language, on the other hand, were much more direct, particularly by the industry engineers. As well as the more general "unacceptable" or even "BAD!", most assessors listed very specific aspects of poor language use, particularly in regard to ESL reports. Incorrect syntax was cited most frequently ("sentence structure", "awkwardness", "sentences not complete", "grammatical errors"). Vocabulary use was also criticized, as in the poor or odd use of words or the need for simplicity ("fluffy"). Even discourse markers were analyzed (e.g., "too much use of words like 'hence' and 'thus'"). Poor spelling as well as overall lack of polish ("needs proofreading; reads like a first draft") were common concerns. A few assessors dismissed the style as "too narrative", with "not enough point form"--or in some cases, "too much point form". Finally, there were a number of reports for which the assessors suspected plagiarism, based on a noticeable shift in style. It is clear that the assessors felt that poor language use affected the acceptability of the report, regardless of knowledge of content (e.g., "Grammatical errors and spelling mistakes diminish the value of reasonably good content

control"). The main concern was that poor language obscured the meaning of the ideas and that even so-called minor errors would not be tolerated in professional reports.

4.8.5 Assessors' Comments Written on Appraisal Forms about Professionalism

The professionalism questions had been added to the assessors' appraisal forms in order to assess their views on technical writing expertise as well as to determine the consistency of their evaluation provided through written comments vis-à-vis their previous scoring decisions.

4.8.5.a Comments on Professionalism in NES Reports

Academic assessors made no comments at all on the professionalism of NES reports. It was therefore necessary to rely only on the industry assessors for feedback on NES students. The industry assessors were quite forthcoming about the professional attributes of the NES reports, sometimes in a very curt way: "BAD"[6], "OK" or "Very good"; or with some tolerance for mistakes ("Good except for slip in not including references"). Different focuses in industry assessors' responses about professionalism are outlined in the following.

In terms of the hiring question (which related to the professional acceptability of the student based on his/her ability as a writer), the following responses were offered by industry assessors to some NES reports:

1.[7]. This student has potential, but seems inexperienced.

2. To make a decision to hire, one has to assess whether a student has the ability to independently analyze a situation and the confidence and the ability to express a

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[6] Quotation marks are used to indicate that these were the exact terms used by the assessors in their comments on the appraisal forms.

[7] Longer quotations are numbered for easier reference.

studied opinion. One assumes that the student has the technical expertise since they graduated. Poor language masks one's ability to determine whether the student has any analytical ability. The simple language in this report makes the student seem naïve.

The second comment emphasizes the importance of an articulate presentation of technical ability. This was usually related to the need for clear communication of ideas to a client:

3. The report seems shallow. This type of report could not be given to a client.
4. The student hasn't understood the topic and has made intellectual jumps. Such a report could never be defended to a client.

The reference to client occurred several times in the industry assessors' comments. A related ability was that of satisfying the purpose of the report:

5. The purpose of this report was to present recommendations. This author sits on the fence, choosing the most popular methods in use. A reader gains little but background information from this report.

This professional engineer seemed to expect a report to recommend action and not simply inform the reader.

In addition to the higher-level focuses on content control, reaching the reader/client and satisfying the purpose of the report, industry assessors also dealt with language and style considerations in their discussion of professionalism. They referred to the NES students' overall ability to read ("The student did not express a thorough knowledge of the reading material. Simplistic conclusions were drawn.") and to write technical reports, including reference to the specific category criteria offered:

6. One of the best reports in this set; well organized and written. The only report with original alternatives.

7. May have adequate engineering skills but would have to improve his ability to write a report in English.

In sum, the concerns about professionalism in NES reports focused primarily on unclear and analytically immature development of the content, along with specific lapses in organizational or presentation elements. References to the potential for client contact demonstrated the industry assessors' sense of audience and beliefs about a definitive test for acceptability of technical documents. In short: "If a client would accept this, I would hire the writer."

4.8.5.b Comments on Professionalism in ESL Reports

There were few comments on ESL reports by academic assessors on overall professionalism, e.g.,

8. This report does not inspire confidence!
9. hard to gauge!

Industry assessors commented in a similar way to the professionalism of ESL reports and on the potential employability of the writers, sometimes positively, but often with some reservation:

10. Unlikely to hire the person. Although English is poor, thoughts are also not well organized or expressed very well.
11. This student has potential and could do professional work with guidance.
12. may be a good engineer

The industry assessors reiterated their feeling that a report should serve a clear purpose, e.g.,

13. Missed the primary purpose of the report; makes unsubstantiated or illogical recommendations

and that the client was the ultimate reader:

14. I feel that I could submit a report written by this student to a client.

The main concerns were about the depth of analysis in the ESL reports:

15. The student makes sweeping statements and then contradicts them in following sections. This shows a lack of deeper thought.
16. The report is too simplistic. The student didn't understand the more subtle aspects of the issues. In addition, poor grammar further reduced the impact of the report.
17. The student has only addressed issues at a surface level. Combined with poor language control, the shallow treatment is unprofessional.
18. Apart from ESL-related problems, this report appears hastily researched & prepared. Many viable alternatives are not mentioned, and the ones that are mentioned are treated with inconsistent depth of analysis.

As is evident from some of the comments listed above, in the case of ESL reports, there were interspersed references to language control even when professionalism or content was the focus.

As they had done with the NES writers, industry assessors raised the question of the reading competence of the ESL students:

19. The student didn't read the sources carefully enough to understand that ballast cleaning is not a solution to the zebra mussel problem. The student has potential with guidance.
20. The only spark of hope is the fact that the student looked up extra sources. Maybe work ethic will bridge a wide language gap after several years of training.

Other issues of style or organization were also mentioned:

21. Should encourage students to use point form which is used frequently in technical/engineering writing

Finally, plagiarism was raised in the comments on the professionalism of ESL reports:

22. Obviously some sections were not written by the author of this report.

The assessors appeared to be suggesting that second language engineering students were generally weak writers. When a couple of assessors suspected plagiarism in a report, they indicated they believed an ESL writer to be more likely to have committed it, even when the report had actually been written by an NES student.

Anomalies in the assessors' comments on the appraisal forms about professionalism were noted:

A number of anomalies were noted in the evaluation of particular NES reports, as in these two comments referring to the same report which had received an original Fail result from the Writing Project markers:

23. good potential but needs training in report writing
24. This report could easily be passed on to a client. The student needs some guidance on style, but that can be learned. The student obviously has learned to think.

It seems that for this NES report, at least, industry assessors believed that conceptual strengths could compensate for any organizational or linguistic shortcomings which may have penalized the report for the original markers. (This report lost most of its original Writing Project marks for inadequate formatting and poor language.) This contrasted with the assessors' typical intolerance for poor language use in ESL reports even when the ideas in them were more or less adequate.

Another example of discrepancy was noted between an original Writing Project result and the assessors' view about the same ESL report, as shown by these comments :

25. The student seems to have a reading or comprehension problem; that, coupled with poor grammar, results in a poor report.

26. Sentence structure and grammar make this report difficult to read.

These last two comments referred to an ESL report which originally received a high Pass result of 83%--why? This report had scored fairly high in all categories in the Writing Project, including a 7/9 for Content and 5/7 for Language, so the breakdown in comprehension and language were not evident to the original Writing Project markers.

In sum, the ESL reports generated similar concerns about professionalism as had the NES reports. However, there were additional references made to features in the ESL reports that made assessors hesitate about accepting them as professional documents. Poor analysis (from poor reading ability) in undirected texts, overlaid with inadequate language, reduced the acceptability of some ESL reports. Industry assessors also emphasized the importance of client-centred writing in the determination of professionalism.

Some industry engineers were hesitant in their positive comments ("may have engineering skills, but..."), but more specific and expansive in their negative comments. Others cited the writer's "fundamental lack of understanding of the problem and the alternatives" as a basis for poor overall professionalism of the report. Their comments suggest that they saw professional reputation at stake in a written product. The assessors also stated explicitly that professionalism was reflected in a technical report through its external components as well as by its presentation of coherent and appropriately selected data. This is highlighted in additional commentary provided by a letter written to me by one of the industry assessors:

> In most things in life, the first impression is important. Engineering reports are the same. The first page or two is critical to having the rest of the report read. This was

probably the biggest weakness in these reports. (R. L., May 29, 1997)

4.9 Summary of Assessors' Comments Written on Appraisal Forms by Category

An analysis of assessors' comments written on the appraisal forms for each category showed that only in relatively few cases did the same reports receive similar types of responses. The comments produced about the reports varied not only by NES and ESL student, but also by type of assessor, with little consistency per report. Nevertheless, the types of focuses and concerns the assessors expressed overall seemed to rise from an underlying common understanding of the necessary traits of an appropriately written technical report.

4.10 Comments by Assessors Written Directly on Reports

The assessors wrote numerous comments on the actual reports which were reviewed in relation to the four prime aspects of the thesis matrix: Academic versus Industry engineer assessors plus NES versus ESL writers, with particular focuses on the evaluation sheet categories of Content, Organization, Format, and Language. Consideration of particular reports is made with reference to their original Writing Project performance levels, i.e., Distinction, Pass, Borderline, and Fail. Even in such a small sample subset there were discernible, and even suggestive, patterns that emerged from the consideration of these variables. These are discussed below in relation to the category focuses the comments seemed to belong to.

4.10.1 Number of Comments by Assessors Written Directly on Reports

With twenty reports in the subset and nine assessors there were 180 reports from which to compile and catalogue assessors' responses. The assessors wrote 1378 comments directly on the

reports themselves, with about 62% of these written on ESL reports. Both academic assessors and industry assessors wrote fewer comments on NES reports (total $\underline{n} = 523$) than on ESL reports ($\underline{n} = 855$). (See complete details about numbers in Table P2 in Appendix P.) Tallies did not include the innumerable use of symbols to indicate a response to text, such as underlining, "!", "?", squiggles or arrows. Of the total number of comments written on the reports, academic assessors wrote more responses (60%) than did the industry assessors (40%). The only notable difference in the intensity of their responses was the fact that twice as many comments were made by industry assessors about the language in ESL reports compared to NES reports; responses to language on ESL reports constituted almost two-thirds of the 855 total comments for that category. About 75% of the 137 comments about format were found on ESL reports, while twice as many comments about organization were made on NES reports (17 compared to 9 on ESL reports) but this category received the least number of comments at only 2% of total. The number of comments about content (25% of total comments) were about equal between NES and ESL reports.

The comments written on the reports by the assessors did not in any way correlate to the original performance levels assigned to the reports by the markers for the Writing Project. Low-scoring reports did not engender more negative comments, and positive comments were not more numerous in the higher scoring reports. Nor was there consistency among assessors about whether a particular report was acceptable. For example, NES report #169 (with a Fail result from the Writing Project) received uniformly negative comments from academic assessors, while receiving only good responses from the industry assessors. In fact, even both Distinction reports (NES #191 and ESL #119) provoked criticism as well as praise.

Since comments on Professionalism were not readily discernible on any reports, this category was not included in the consideration of comments written directly on the reports. Not all

of the comments written on reports by the assessors are included; instead, the lists of quoted comments are representative of the total, both in focus and in number.

4.10.2 Assessors' Comments about Content Written Directly on Reports

The most common provocation to a reader is, naturally enough, the content presented in the text being read. Along with responses to language, reactions to the ideas presented in the student reports were the most numerous and engendered the greatest intensity in the assessors as critical readers.

4.10.2.a Academic Assessors' Comments about Content Written Directly on Reports

The comments and symbols written in the margins by the academic assessors covered both higher level and more specific aspects of the twenty reports they each read. The most typical kind of responses[8] were directed to particular content details presented in the reports:

1. But...stopping ships from dumping more mussels won't reduce the current infestation!
2. This does not make sense since the mussels can and do attach themselves to the rock surfaces in the lake!

The assessments of the student's understanding of the problem and how to deal with it were frequently quite critical:

3. inadequate, poor grasp of the subject
4. I think this student has not understood the purpose of the report.

Academic assessors also made general comments about the student's approach to content:

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[8] Comments continue to be provided verbatim. Quotation marks indicate exact terms used, while longer comments are numbered for reference purposes only.

5. The scope of this solution is not well presented!

Although academic assessors praised students for doing additional research (e.g., "This student has acquired extra information on the subject--very good approach."), they more often criticized the report writer's inadequate level of reading comprehension:

6 This student appears to have spent a lot of time reading extra material on the subject. Unfortunately his/her English is very poor and the report is virtually unreadable.

Far more of these comments about reading inadequacy were directed to ESL writers than to NES students. In addition, criticism of poor language control accompanied many comments on content control, as in the following written on an ESL report:

7. This student is incapable of clear thinking and/or clear writing in English.

Style and organizational or formatting features were frequently referred to in terms of how they presented the ideas:

8. While the style of the report is not bad, it is quite impractical.

Almost every report, whether written by an NES or ESL student, provoked some kind of negative feedback from the academic engineers. However, there was no systematic agreement among the academic assessors with the criteria as interpreted by the markers of the Writing Project.

4.10.2.b Industry Assessors' Comments about Content Written Directly on Reports

In their responses to the ideas in the reports, industry assessors focused on similar aspects as the academic assessors had. Specific comments on content predominated:

9. It is likely that zebra mussels need the same nutrients that other species need at the same level in the food chain. This idea is a faint hope, but it is an original idea.

Originality was noted, although rarely:

10. This is not stated directly in the source material so the student does know how to put ideas together.

Most industry assessors stressed the students' inability to differentiate the focuses and purpose of the task:

11. The student does not make a distinction between prevention of other similar infestations and reducing the effects of this one.

Students were also criticized for not clarifying which solution or recommendation they were promoting:

12. What is the recommended approach?

And industry assessors particularly noted evidence that the depth of analysis in the reports was insufficient:

13. People costs can be high. Do a more complete analysis; 250K may not be high??

Industry assessors occasionally questioned the source of the ideas presented, but to a lesser extent than the academic assessors did. Comments about students' poor reading ability or incomplete comprehension of the topic were frequent, but especially in the reports written by ESL students:

14. The background papers indicated that endod was specific. Does the student have a reading problem?

ESL reports also generated far more comments about how language use affected writing:

15. The student has looked up a lot of additional material, yet much of this new information is masked by poor use of language.

Even rhetorical focuses were mentioned:

16. off topic
17. Arguments are not well developed.

The extensive comments written on the reports in response to content confirmed to a large degree the same kinds of concerns the assessors wrote on the appraisal forms, namely the ability to distinguish between alternatives and recommendations, to understand and select appropriate ideas from the source material, and to present the ideas clearly in accurate language.

4.10.3 Assessors' Comments about Organization Written Directly on Reports

In the flow of reading a document a reader is not likely to react to organizational aspects unless these are blatantly inappropriate. This was the case here. Assessors wrote few comments about the organization of the reports in the reports themselves. Most left their post-reading assessment of organization to the comment boxes on the appraisal forms. Nevertheless, there were a few instances of within-text responses to organization which are reviewed briefly below. In order to maintain consistency, comments were compiled under Organization on the basis of the criteria list within this category on the appraisal forms.

4.10.3.a Academic Assessors' Comments about Organization Written Directly on Reports

There were very few comments written by academic assessors in the reports themselves about their organization. Two semi-positive exceptions on ESL reports included:

1. The organization is fairly good but the skill required to write clearly is missing.
2. This report is reasonably well organized, but lacks a discussion of the effect of the....

Similar to how they marked this category on the appraisal forms, academic assessors linked organization closely to control of content or language use instead of judging it as an isolated characteristic of the report.

4.10.3.b Industry Assessors' Comments about Organization Written Directly on Reports

Much like the academic assessors, the industry assessors reacted only infrequently to organizational aspects in the course of reading the reports. In some NES reports, however, industry assessors focused on placement of data, referencing, and inclusion of necessary report components, as these examples show:

3. Again, the student seems to understand the problem. A table of pros and cons would have been very useful.
4. explicit references?

Logical order remained a primary concern:

5. Prevention of other problems, not a solution. Should not be in this section.
6. ...not in a 'standard order'. It shows inexperience.
7. The discussion of alternatives and the background are mixed in this report.

This last comment (#7) was one of only two responses to organizational aspects in ESL reports (per the criteria listed under the Organization category). It appears that assessors generally found ESL reports to be adequate in managing organizational features.

The main focus for most assessors was the appropriate and relevant placement of content under the proper headings rather than a broader or more holistic analysis of organization as a conceptual framework for the ideas in the report.

4.10.4 Assessors' Comments about Format Written Directly on Reports

A technical document is often seen as being most publicly recognizable by its formatting. The students in the Writing Project had been given guidelines and examples of engineering reports. Furthermore, the very specific criteria should have all but

eliminated errors in this aspect of technical writing. However, some assessors still found formatting-related features of the student reports that were inadequate in this regard.

4.10.4.a Academic Assessors' Comments about Format Written Directly on Reports

There were very few comments in the reports by academic assessors with regards to formatting. Most of these comments centred on the number of sub-sections and on appropriacy of the titles for the sections, apparently more an NES problem than an ESL one. The following examples highlight these two major concerns:

1. inappropriate heading
2. This does not make sense! Why introduce copper coating when the heading is silicone?
3. The heading is inappropriate for the first two sentences.

Another major concern of the academic assessors was that of missing sections and of poor references, a deficiency far more prevalent in ESL than NES reports:

4. only sub-heading in section?
5. [re: bibliography] should quote the original sources provided
6. authors?
7. reference?
8. quote attributed to Garrie?

Academic assessors questioned the students' source of data far more than did the industry assessors. In two instances, however, an assessor was pleasantly surprised at a rare appropriate example of sufficiency in ESL reports:

9. good! reference to figure!
10. good! reference to table

4.10.4.b Industry Assessors' Comments about Format Written Directly on Reports

Industry assessors did not comment as much on format in NES reports as they did on other categories. All comments were negative and picked up the same problems as the academic assessors' comments had highlighted, along with problems in punctuation,

11. all caps; see last page, not caps

and general style and mechanics. (Several industry assessors also checked off bibliographies with a √.) Examples of these focuses are:

12. This report does not follow a report style.
    [This assessor actually inserted headings like 'Statement of Purpose', 'Introduction', etc.][9]
13. One cannot use a footnote to complete a sentence.

Nor did assessors deal much with format in ESL reports. Several examples highlighted the missing elements and stylistic requirements:

14. Use the same font size.
15. list could be helpful
16. point form would be better than Firstly, Secondly.
17. very short introduction
18. poor structure of text
19. [Table of Contents] Section missing
20. It is good to include references, but they shouldn't break up sentences.
21. The Bibliography should follow a style sheet.

Carelessness and poor management of text production were also noted in ESL reports

22. Text seems to be have been reformatted with extra spaces. This shows that the student doesn't know how to use a word processor.

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[9] Square brackets either give explanations about the content of a comment or about some action taken in the report by an assessor.

The examples of responses to Format in NES and ESL reports were similar, but the ESL reports were also criticized more often for not having mastered aspects of basic computer literacy such as word processing and control of mechanical elements.

4.10.5 Assessors' Comments about Language Written Directly on Reports

In the assessment of many kinds of written work, the language used in it provokes an often passionate response from critical readers. This was certainly the case here. In addition to actual comments about language use, many assessors circled, underlined or corrected syntax and vocabulary, or wrote "ugh!", "!", "?", "√" or other symbols in the margins of the students' reports.

4.10.5.a Academic Assessors' Comments about Language Written Directly on Reports

Although one could anticipate that reports that failed or reports written by poor ESL writers would generate the most criticism this was not a pattern here. NES reports, even ones which had originally passed with high marks, were also criticized for poor style, use of colloquialisms, weak paragraphs, or overall unacceptable quality of writing (e.g., "This is not up to standard!"). Examples of positive or mixed reviews about language used by NES students included:

1. the author of this report can express himself/herself in the English language
2. The organization is fairly good but the skill required to write clearly is missing.
3. colloquial style
4. ...the quality of writing is unacceptable.

Colloquial language was clearly not appreciated in a technical report, indicating that the academic assessors had a strong sense of the register of their discipline.

In some cases, the academic assessors, who knew that some reports had been written by non-native writers of English, frequently thought that a poorly written NES report must therefore be an ESL report, as the following, and other similar comments, showed:

5. This student uses English words but the expressions must have come from another language!

However, ESL reports, more than NES reports, generated specific comments from the academic assessors about the misuse of particular syntactic or lexical items, along with the usual general criticism:

6. He/she used inappropriate verbs showing poor command of the English language.

Inadequate reading comprehension was noted in ESL reports, often as a feature of low language proficiency:

7. Poor command of English language, hence inability to understand the story of how zebra mussels arrived in Canada.
8. This student appears to have spent a lot of time reading extra material on the subject. Unfortunately his/her English is very poor and the report is virtually unreadable.
9. Marginal command of English.
10. Bad grammar
11. ...and the English is terrible.
12. There are many errors indicating that the author lacks control of the English language.

The single positive response to language in ESL reports was nevertheless still mixed (and surprised?):

13. This is a well written report, with a few errors here and there!

The last comment (#13) referred to the only ESL report in the sample subset with an original Writing Project Distinction level. The academic assessors' main concern with this ESL report was lack

of practicality in its solution and occasional lapses in language usage, which reduced its scores in the evaluation on the appraisal form. This suggests that even a minor level of language inadequacy will skew the results for an otherwise adequate report since its scores from the academic assessors did not generate a Distinction result.

4.10.5.b Industry Assessors' Comments about Language Written Directly on Reports

In addition to comments about specific aspects of lexis, syntax or style, many industry assessors underlined parts of text, corrected spelling or word choice, or questioned sections of the report. However, unlike the comments made by the academic assessors, those made by industry assessors were far more often critical about very specific syntactic and lexical errors.

Examples of industry assessors' negative responses to language in NES reports showed a preoccupation with all aspects of syntactic and rhetorical features:

14. [re: 'wash-up'] the use of coined words implies a good command of language
15. bad use of connectives
16. verb tense
17. awkward structure
18. not good writing and not very technical
19. Lots of THIS and THAT, which make the report sound like hand waving.
20. short choppy childish sentences

On ESL reports, industry assessors' even stronger (and negative) reactions to the language used there included:

21. not good English
22. colloquial
23. dangling
24. not written well

25. bad! bad! bad!
26 run-on, confused sentence
27. make more than 1 sentence
28. no subject
29. [re: 'exert'] strong word to use
30. missing verb
31. adverb problems
32. wrong article
33. poor use of connecting phrases
34. The student seems to be struggling with language.
35. One shouldn't start with a negative. ('non-technical'). It would have been better to use a positive word such as 'High Level' or 'Analysis'.
36. bad phrasing; no verb; sentence breaks are missing
37. This sounds more like political rhetoric rather than technical language.

This last item (#37) is one of the rare references to register or to rhetorical intent. An objection to lack of objectivity was also noted:

38. too personal; write in a more technical manner

It is clear from the long (and non-exclusive) list above that industry assessors, at least, felt very strongly about language usage and were provoked to respond to poor language control in ESL reports more often than in NES reports. They noted all aspects of language, from extremely specific syntactic errors to discourse features to overall style, which was deemed "not technical". This following comment may sum up the assessors' attitude concerning the importance of language in a technical report:

39. This student doesn't have control over prepositions and tenses. If a report doesn't sound professional, it is not given credibility.

4.10.6 Discourse Analysis of Comments Written by Assessors about Content

The comments written by the assessors on the reports about the actual content or other feature of the texts they were reading provided one type of information about the acceptability of the students' writing. Another form of analysis was also undertaken of the nature of the comments themselves, particularly in terms of whether the assessor was working within academic or industry contexts. It was found that the comments written spontaneously on the reports indicated some differences between academic and industry engineers in terms of how they responded to text.

Table 4.4 (over the five pages starting on p. 183) provides a summary overview of the types of comments and examples written by both academic and industry assessors on NES and ESL reports. Most assessors wrote margin notes which dealt specifically with points raised in the report. In questioning the data, the comments were mostly negative rather than positive and focused on the accuracy of the information or the writer's grasp of the subject. There were a variety of ways in which the assessors did this.

One discursive feature in the assessors' comments was noted in how they dealt neutrally with errors in data: they criticized the report or the writer in a non-directive manner, in the third person. Their acknowledgment of students' attempts to incorporate additional research information tended to continue this type of third-person assessment. Another way of commenting was to raise non-directive questions about topic details. These comments were considered separately since the intended audience was not specified by the assessor and could therefore have been either the original student writer or a third-party reader. The assessors also used this type of non-directive comment to question the student author's reading comprehension and subsequent style and presentation of the data. Comments about reading competence occurred more frequently on ESL reports and were written more often by industry than academic assessors.

A much more engaged reaction to the content in the reports took the form of questions specifically directed to the student writers, in which the writer was addressed in the second person. Academic assessors predominated with this directive form of response, while industry assessors tended to maintain a neutral stance in the majority of their comments, either by correcting the data or talking about "the student" or "the report". It became apparent that these industry assessors tended to maintain a more objective distance as readers than did the academic assessors.

Another form of non-content-focused response written by the assessors was straight commentary on the report as an example of written technical text.

Although not exactly the same type of meta-discourse, the assessors' criticisms of poor language skills which accompanied comments on content control could be seen as examples of distracted focus, or reader overload. The assessors were trying to deal with content but apparently found their attention distracted by confusing or inaccurate language. This was particularly apparent when they commented on ESL reports.

Finally, a different sort of response from the types outlined in Table 4.4 was the extensive use of expressive punctuation, primarily by the academic assessors:

1. who is he?--a rock star!?
2. NO!!
3. ??? not likely!!!
4. A boar wash??

These were only a few examples of this frequent type of response by academic assessors. This extensive use of expressive punctuation was in marked contrast to the more restrained reaction by the industry assessors who only used this response style a couple of times, as shown in this rare example:

7. Why would be more required if an 'effective' concentration was used for 'sufficient' duration!?

Table 4.4
Comparison of Types of Focuses in Relation to Content Written by Assessors Directly on the Reports

		Examples of Assessors' Comments	
Focus on Content	Students	Academic Assessors	Industry Assessors
1.a. Non-Directive focus on student's control of content (The focus is on the content. The comment is not directed toward the student but to the report, rhetorically, or to the next reader.)	NES	a. This student has no appreciation of the subject! b. I am not sure this student has understood the information in the articles on zebra mussels.	c. Again, the student is thinking. This requires deducing a concept from multiple sources. d. There is some level of understanding here. e. Providing a good environment for the mussels will just support a larger population. This thinking is naive. f. I can't believe the student is suggesting UV light and CO_2 in the whole Great Lakes.
	ESL	a. I don't think this student has a clue about the basic parameters of the problem b. This student has acquired extra information on the subject--very good approach. c. This student appears to have spent a lot of time reading extra material on the subject.	d. The report should discuss trade-offs.

Table 4.4 (cont.)

Focus on Content (cont.)	Students	Examples of Assessors' Comments: Academic Assessors	Examples of Assessors' Comments: Industry Assessors
1.b Directive questions about content presented in the third person form (These are likely directed to the student but appear to be addressed to the report or to the next reader. They reflect a distancing of the assessor from direct engagement with the student.)	NES	a. How does this stop zebra mussels? b. What if 30m. depths are not locally available? c. Why not shoot them with lasers? d. ...what effect will it have on native aquatic life? e. summary of what? f. like the whole of Lake Ontario?	g. How does this deal with the current problem of Zebra mussels?? h. Who said it was simple to remove chlorine?
	ESL	a. But what about the effect on the colour of the water? b. Why not use filtering instead? c. Does this mean breaking the food chain is the upside? d. So how does this cause a problem? e. How does one generate water? f. for what? g alternatives? criteria?	h. There are several related problems. If the one being addressed is the spread of mussels, then why are the solutions about the pipes?

Table 4.4 (cont.)

Focus on Content (cont.)	Students	Examples of Assessors' Comments: Academic Assessors	Industry Assessors
1.c Directive Questions or Comments directed to the student writer addressed in the second person form ("you"), stated or understood. (These are interactive questions or comments that involve the assessor/reader more closely with the student writer.)	NES	a. You should have described the techniques for fighting mussels in a little more detail. b. Great idea, but do you know of such a plant? c. I am not sure that you appreciate the effect of your recommendations on other aquatic life and the cost of the operation. d. Chlorine is also soluble in water, so according to you it should not accumulate in the water.	e. Whose recommendations are these? Yours or someone else's?
	ESL	a. I don't think you understand what you are trying to describe!! b. Your recommendations are fuzzy. c. You didn't understand the readings you were given.	d. what do you mean? (Note: There were only 2 such direct questions from industry assessors)

Table 4.4 (cont'd.)

2. Focus on Language Skills	Students	Examples of Assessors' Comments: Academic Assessors	Industry Assessors
	NES		
2.a Criticism of poor reading comprehension (The focus is on the student's ability to comprehend the data presented in the source materials as evidence for level of content control.)	ESL	a. Poor command of English language, hence inability to understand the story of how zebra mussels arrived in Canada. (Note: There was only one example of this kind from academic assessors.)	b. Electricity won't work inside metal pipes. This is stated in the articles, but I don't think the student understood it. c. The sources say once the mussels are introduced it is too late. This effort is for future problems. (Student did not read carefully or understand.) d. The background papers indicated that endod was specific. Does the student have a reading problem? e. [re. use of Melitta filters] And make coffee! I think the student has difficulty reading and comprehending. f. Not what the sources say. Veligers are too small for almost all filters.

Table 4.4 (cont'd.)

Focus on Language Skills	Students	Examples of Assessors' Comments: Academic	Industry
2.b Criticism of poor language affecting content control (This shows how assessors were distracted by their concern for language use in their assessment of content control.)	NES		
	ESL	a. This student is incapable of clear thinking and/or clear writing in English. b. Poor command of English, hence inability to understand the story of how zebra mussels arrived in Canada.	c. The student has looked up a lot of additional material, yet much of this new information is masked by poor use of language. d. The person seems to be struggling with language.
2.c. Metadiscourse about format and rhetorical control	NES	a. [re: summary list of recommendations] too brief!...reader does not yet know enough to decipher these b. [re: table] good summary	c. This is a good summary because it really summarizes the report. d. Sweeping statement based on partial facts. e. The criteria are listed but not followed.
	ESL		a. too personal; write in a more technical manner. b. This sounds more like political rhetoric rather than technical language.

Notes: Some comments listed could be considered more than one type but have been placed under the more typical focus.

The two main types of comments are divided on the following bases: 1) the assessors' focus on content, and 2) the assessors' evaluation of the students' degree of proficiency in language or rhetorical skills. (The assessors knew that the student writers would never see their comments.)

In sum, there were several types of responses by the engineers to the reports, which ranged from third-person criticism of the student's grasp of the subject matter to questions about specific data, use of expressive punctuation, criticism of the report overall or in terms of its main sub-sections, and criticism aimed directly to the student writer. In all types (varied across the assessors) the motive underlying all the comments appeared to be a deep interest in getting the facts straight, and in getting the report (and, in turn, the writer) into acceptable shape. This conclusion is purely speculative, but remains one possible interpretation of the type of comments.

4.11 Summary of the Analysis of Comments by Assessors Written Directly on Reports

The number and types of reactions written by the assessors directly on the reports themselves illustrated the extent to which these engineers were engaged in their assessment of student writing. In the main, both academic and industry assessors reacted strongly to the presentation of data and to the language employed to present the facts. Despite differences in their focuses or way of responding, both groups of assessors seemed equally concerned about style as well as substance, and both were generally highly analytical and specific in their responses, thus confirming how important it was for them that a report be clearly written, well organized and effectively packaged.

4.12 Reasons Given by Assessors for Deciding Whether the Report Writers were NES or ESL Students

Guessing whether the report writer was an NES or ESL student was intended to be a final holistic decision on the part of the assessors. The question on the covering instruction sheet asked the assessors to make this judgment when they had already scored and commented on the reports. Reasons for their decisions were also requested.

4.12.1 Reasons Given for Deciding Reports were by NES Students

The reasons[10] given by assessors about deciding that a report had been written by an NES student were both vague ("readable", "Language") but also more specific. A number of common reasons are highlighted first and then specific differences in judgment are presented.

Reasons for deciding a report had been written by an NES were almost invariably positive. Typical reasons included:

1. clear, natural flow of sentences and paragraphs
2. normal word order
3. easy to read
4. smooth writing
5. very good vocabulary and grammar
6. natural grammar and writing style

For the one NES report with an original Distinction level assessors wrote positive comments about its "natural" or "readable" language and added:

7. Language control is good. The student appears to have read technical material in English, since the style of the report flows well.

The concepts of naturalness, clarity and flow predominated in the overall comments for the correctly guessed NES reports. Even some reports that assessors thought were inadequate were nevertheless still identified as NES:

8. weak NES (no consistent grammar/English problems)
9. In spite of poor grammar at times, the writing style and language is quite natural.
10. Some sloppy work! But no consistent errors (therefore, not likely to be a 'translation' problem).

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[10] All written comments by the assessors are presented verbatim, with no attempt to correct or annotate any grammatical or mechanical errors.

Although they did not define it, the assessors apparently felt confident that so-called natural or native use of English was discernible. Furthermore, they distinguished between language-based errors and simple sloppiness or typing mistakes. Assessors did not clarify how they saw language control and the concept of style as different.

There were three NES reports, all of them at the Pass level, which neither group of assessors was very successful at identifying. NES reports at the highest level and the two lower levels were easier to identify correctly, but NES reports in the middle range presented aspects that confounded accurate guessing. The main basis for this hesitation tended to be linguistic, either as a vague dissatisfaction with the language or because of specific linguistic features ("unnatural grammar"; "not English style"). For example, the reasons assessors gave for deciding NES report #23 was an ESL report included:

11. Trouble with 's' seems to be an ESL-student difficulty.
12. Inappropriate plurals, although most grammar is indicative of NES.
13. Some of the language seems professional, whereas other parts seem childlike.

In judging that report NES #33 was an ESL report, those assessors who provided a reason also signaled language features:

14. The lang. is largely in the present tense & is 'simple'. Tenses are mixed. The report does not sound 'detached' & 'analytical'.

From the relatively moderate success rate of 70% for guessing NES reports, it is apparent that as a group the assessors felt many of the <u>same</u> reports could have been written by either NES or ESL students. Only the NES Distinction report got full (and accurate) agreement from all assessors. In all other cases, the assessors' opinions were sometimes diametrically opposed about the same piece of writing. For example, one NES report received both approval ("natural grammar and writing style") and disapproval ("poor use of

English"). Or, in another NES case: "natural flow; clear, easy to follow" contrasted to "Organization of sentences and grammar is awkward". In short, even for NES reports, there was no full agreement from these assessors about whether and to what degree a document met native-English standards.

4.12.2 Reasons Given for Deciding Reports were by ESL Students

Much like the NES reports, the ESL reports received mixed reviews in the assessors' reasons about their writers' NES or ESL status. Although the simple reason "Language" was frequently given, the assessors also made very specific references to linguistic features. However, the same reports could be chosen or rejected as NES or ESL for contradictory reasons, as outlined following.

Only one ESL report garnered total agreement: Report #198, originally a Pass-level report, received all eight assessors' accurate guesses as being the product of an ESL writer. To explain this consensus, assessors' reasons included:

1. Very hard to read! (English is not comfortable); I feel as though I am reading a translation from some other language into English.
2. prepositions missing; poor sentence structure; verbs incorrect, etc.
3. no (not NES), poor English
4. Student misses verbs, articles and prepositions & uses the wrong tense. The poor language control masks the ideas expressed.
5. Missing words, unnecessary words, inappropriate plurals, poor sentence structure, poor grammar

The other ESL report with high agreement overall and total consensus from the industry assessors was #226, which originally failed. It generated similar remarks by assessors to explain their high accuracy rate of 88% in guessing it to be ESL (with no dissenting views recorded). In this, as in a number of cases, some

assessors were obviously jarred not only by specific lapses in language use ("errors in tense"; "poor use of prepositions"; "inappropriate plurals") but by what seemed to be a lack of appropriate linguistic processing by the writer:

6. The writing does not feel comfortable with English (translation?). Some problems with plurals.

ESL report #170 was an original Borderline for which assessors offered these reasons for selecting it as an ESL product:

7. This report is unreadable! Weak grammar; consistent errors, e.g., 'the' is not understood.
8. The student drops pronouns, misuses adverbs, uses the wrong tenses and makes almost every grammar error possible. From the poor control of pronouns and verb tenses, I would guess an Oriental language background.

(The student writer was a native speaker of Croatian.)

The ESL reports with the lowest accuracy rates (i.e., considered by more assessors to be NES) included the ESL Distinction report #119, for which the assessors praised its "natural command of English" and said:

9. The student seems comfortable with language. There is a good use of compare and contrast connectors.

Yet the two dissenting opinions (both industry assessors) also cited language as determining their guess that this same report, #119, (Distinction) must be ESL, specifically because of its

10. Occasional lapses in grammar & awkward titles ('Overview of Alternatives by Table')

The other ESL reports which had low accuracy rates (and hence, were considered NES-like) were #61 and #137, both originally at the Pass level, and #90, a Borderline report. Each was considered separately as follows: Report #61 had a vote split evenly between academic and industry assessors. The assessors who felt it was an NES report wrote about its "natural sentence construction

and grammar" and its "good command of English". In contrast, in deciding that this same report, #61, had been written by an ESL student, assessors included reasons like:

11. Consistent grammatical problems (e.g., starting sentences with 'Since...' even though the word causes grammatical problems in the rest of the sentence).
12. use of prepositions; verb tense; 'the' used too often
13. The student makes minor grammar errors that make it sound as if he/she is thinking in a different language.

The other ESL Pass report, #137, won more votes in favour of its being by an NES rather than ESL student. Those assessors who read this ESL report as an NES report said it was "readable", "clear, concise, easy to read", and stated that "Although grammar is often suspect, the basic sentence structure is natural." Nevertheless, this same report showed itself to one assessor to be ESL because:

14. The student has trouble with sentence structure and prepositions and articles. Chinese?

(The student's mother tongue is actually Setswana, from the African country of Botswana.)

ESL report #90 was a Borderline report which also gained more votes towards NES status. Despite one dissenting, and accurate, view that it was ESL due to "certain expressions and misuse of some verbs", the other assessors who judged it, wrongly, to be the work of an NES student also wrote about "readable", "natural sentence construction and flow of paragraphs" and overlooked its "minor grammar errors".

Of the remaining ESL reports which gained a majority of votes in favour of their being NES, one, #185, had been given an original Fail result yet was scored comfortably into NES status because the assessors said it had "natural grammar and sentence structure" and felt that

15. Control of language is good. However, the student uses broad statements and connecting phrases that are

unjustified. It gives the impression that the student is hesitant about his opinions.

However, the assessors who gave reasons for believing the same report (#185) to be an ESL report did so on the basis of its language, specifically, its "Consistent grammar problems", and noted its

16. poor sentence structure; long non-connected ideas; prepositions misused

Two ESL reports which gained an agreement of almost 88% each (that is, for whom the assessors felt their writers seemed more like non-native speakers of English) were reports #106 (originally a Pass) and #180 (originally a Fail). In addition to citing specific language features for #106 assessors also said:

17. This is a sloppy report. Either weak NES or weak ESL with reasonable attention to editing.
18. Content

This last reason was a rare decision about mother tongue related to non-language features. It suggests that the assessor felt that the report was out of touch with the topic in such a way that the writer was somehow identified as a non-native speaker of English. The only assessor to give a reason for selecting #106 as an NES report said it had "natural language" and was "easy to read".

Although #180 gained one vote in favour of its being NES ("natural flow; reads well"), most assessors believed it showed ESL problems for the usual discrete point errors in language, but also remarked:

19. The student has poor control over prepositions and tenses. A paper that doesn't read well, or is full of grammar errors, is not given much respect, and the author is not treated as professionally.

This last statement is particularly salient since it expresses explicitly what many assessors were implying in their criticisms, namely that a properly professional piece of technical writing must

show mastery of even the minutest of syntactic, lexical and mechanical aspects, even when poor examples of these do not impede basic communication. A professional is not sloppy.

4.13 Summary Conclusion to the Results of Assessors' Evaluations

The academic and industry assessors who evaluated the ten NES and ten ESL students' reports showed both similarities and striking differences in their judgments. The two types of assessors were significantly different in their assessment behaviour when compared as groups: academic assessors scored the reports more like the WTS markers for the Writing Project but industry assessors scored the reports differently both from the way the academic assessors had scored and from how the WTS markers had scored.

When the assessors' scoring patterns were analyzed specifically for reports written by NES and ESL students, stronger differences emerged. The correlation between the means of all assessors and the Writing Project markers was stronger for the NES students than for the ESL students. When the academic and industry assessors' scores were compared to the original Writing Project scores for NES students only, the academic assessors continued to show similar scores to those of the Writing Project markers for these NES students. Industry assessors, however, differed significantly from the Writing Project markers in how they scored the NES students.

The analysis of scoring for only the ESL students revealed a similar pattern in the scoring behaviour of the assessors. The nine assessors seemed to be similar as a group to the Writing Project markers in their evaluation of the ESL students. However, when the scores for the academic and industry assessors were compared separately for the ESL students in the subset, there were again significant differences. The academic assessors marked the ESL students' reports in essentially the same way as had the Writing Project markers. However, the industry assessors differed significantly from the Writing Project markers and from the

academic assessors in their assessment of these ESL students' reports.

An analysis by report and performance levels showed that the industry assessors tended to blend their scores such that those reports which had originally scored in the upper and lower levels on the Writing Project reports were brought into the middle Pass-level ranges. In terms of scoring behaviour by category, the nine assessors' closest point of agreement was for Format, but they differed significantly for the other four categories on the appraisal forms.

In their comments both on the appraisal forms and written directly on the reports, assessors focused on content control and language, although in different ways and to different degrees of engagement. Academic assessors, for example, engaged more directly with the student writers through their comments, while industry assessors maintained a more distant stance in their criticism and made more critical responses to lapses in content and especially language. ESL reports were criticized more often for demonstrating both linguistic difficulties and the author's lack of reading comprehension and inadequate understanding of the subject. Both types of assessors also focused on discrete language features in their reasons for deciding whether a report had been written by an NES or ESL student. The assessors generally agreed on the aspects of the reports which could be improved, but there were also marked discrepancies and even direct contradictions in the assessors' evaluations of particular reports and in the reasons they offered for these judgments.

4.14 Additional Input from the Assessors

The comments written by the assessors on the appraisal forms and on the reports themselves were valuable sources of insight about the reactions of professionals to the novice attempts by engineering students to produce acceptable technical reports. In addition, some assessors felt compelled to write independently from

the assessment procedure outlining their views on technical writing, on student writing in particular, or on the process undertaken in the study. Personal discussions also supplemented the input to the qualitative data. Since these kinds of input were quite ad hoc and not solicited systematically, they were considered additional rather than central sources of thesis data (and therefore not included in the Methodology). The letters and brief notes[11], some of which are presented below, covered all aspects of the writing task and included comments from the assessors in both the pilot study and the thesis research. The first two, relating to the research study on the zebra mussels report, concentrated on organizational and linguistic aspects more than simply the students' demonstration of content knowledge. The first extract presents some of this industry assessor's comments:

> *As a rule, I prefer to see a brief abstract (5 to 10 lines) introducing the topic. (in this case, a statement of purpose) followed by an executive summary (max. one page containing main conclusions). Most of these reports did not follow this type of opening. This tended to make for poor flow to the report. Quite a few had reasonable content but the organization was not good. I believe I used the term 'poor assembly' several times. Generally the intensity of the recommendations was good, indicating to me some thought had been given to the subject. There was some problem with language structure, brought about in some degree, I'm sure, by the second language feature of some of the writers. However I'm sure some of my 'guesses', vis-à-vis NES or ESL, are off base because some NES writers have the same problems (myself included). Grammar and spelling have never been a big hang-up on my part and I don't usually notice unless 'glaring'.*
>
> *In most things in life, the first impression is important. Engineering reports are the same. The first page or two is*

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[11] These letters and notes have not been edited.

critical to having the rest of the report read. This was probably the biggest weakness in these reports.

There are several interesting comments here that reflect strong feelings about appropriacy in technical report writing. First, the assessor (a chemical engineer working in industry) is clear on what he expects in terms of format and general organizational features. When he says that the lack of abstracts or executive summaries "make for poor flow to the report", he seems to be suggesting that he could not follow the ideas as easily because the reports did not follow expected norms. Abstracts and executive summaries are generally learned as formal constructs; they are not common features of the traditional or more familiar (often oral-based) story-telling style that most novice writers would tend to follow in presenting ideas[12]. One has to learn to break or precede a natural story with summaries of any kind. (In Swales' sense, many students, both NES and ESL students, are at a "pre-genre" stage (1990, p. 59), not yet having learned enough formal, or post-oracy, text types.) So when this assessor talks about poor flow and poor assembly he is making a relative judgment entirely specific to his internalized professional experience. He feels upset because the student writer has not followed his own learned expectations about technical writing.

In reference to judging whether the report writers were NES or ESL students, he also implies that for him errors of syntax and spelling would be the primary signals of a poor writer, in this case, not just of ESL writers but of poor NES writers as well. Finally, the reference to first impressions suggests that he is very aware of the social aspect of format. If a report does not draw in the reader, then reading will stop, and unread reports could have professional consequences (i.e., be lost to a client) or at the very least provoke irritation in the reader.

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[12] Most pre-university writing programs focus on story-telling or arts-oriented academic writing rather than technical writing, with the exception of pro-forma lab reports for science courses (Geisler, 1994).

Another letter, this time from an academic assessor, accompanied the return of one of the last sets of reports and included these comments:

Table: if present, not referenced from text

Bibliography vs. Footnotes/Reference - generally weak; often includes entries that are never referenced

Does a footnote add content or merely a reference?

The handling of plurals is sometimes weak (I suspect that ESL students may have some problems here!)

Students tend to "borrow" phrases from references, e.g., "mussels are no bigger than a person's thumb"

General loss of scope in reports: recommendations can only deal with minimizing damage in pipes--a general "cure" is not likely! The lakes are permanently infested!

After reading a few weak reports it is sometimes difficult to stay objective while reading subsequent reports.

Cost is often listed as a criteria for evaluation, but only vague statements (not quantitative!) are given, e.g., expensive, not expensive -- no $$values, -no $$ justifications are given

***I did not comment on hiring the writers as junior engineers.*

I found professionalism hard to gauge, particularly when the content did not inspire confidence.

These comments reveal a number of expectations. The first is that a table in a report ought to be referred to within the body of the text; there is expected protocol on how to deal with statistical or non-prose data. He also complains that referencing requirements were not always followed by the twenty report writers, but nevertheless assumes that it is not only desirable to do so but that any reader should know what he meant by these requirements. When this academic assessor says students "tend to 'borrow'" he is clearly referring to plagiarism, with the underlying implication that this is not acceptable. He then makes a comment about the students'

understanding of the topic, (with !) suggesting he is shocked (?) or simply critical of the lack of insight. (Given the sequence of these comments, is he suggesting that students who plagiarize do so because they don't really understand the input?) Finally, he says it was difficult to remain objective in light of the weakness in a series of reports, an admission which reveals that even while attempting to maintain objectivity in assessment a reader may be swayed by the quality of prior reading experience.

In the pilot study, which required a report on an ethical question, several assessors wrote letters independent of their evaluation responses. These were interesting enough in their own right that they merit reproduction in part here. The comments have been grouped according to the major focus presented.

One aspect that was repeated was the need to make a good impression, a requirement that includes both personal and professional pride. Three examples follow with the type of assessor indicated in brackets:

> *They should know that their writing is very personal in that it gives others an impression of them and they should start to take pride in this little part of them that others will be looking at and judging.* [industry]

> *Some of the statements made in these assignments infringed basic rights so severely that they would have caused riots among the employees. The message for some of these students is that they should have given the assignment exactly the same care that they would have done if it had been a real situation.* [industry]

> *[N]one of these reports are of a caliber I would accept from a professional.* [industry]

Other comments emphasized the need to be both rigorous in the application of conventional formatting rules and creative in the analysis of the problem:

Some of these students were marked low not for the creation of English, but rather for a dismal analysis of the problem, combined in some cases with an unattractive mosaic of phrases taken from literature in ethics. This is the classic problem of immature writing where students try to achieve quantity rather than quality. It is very doubtful whether such a strategy has ever worked in their schooling and it certainly won't work here. The message: (a) the writing should be the exact length the task seems to call for; and (b) it should be totally original. Maybe some of them need to be told to lighten up, take risks, and let it all come from inside. There was much room for creativity in this assignment, and the best examples I saw were the most original. [industry]

The requirement for structural conformity was expressed by another engineer:

I am amazed by the diversity in the format of the responses; obviously the students were not given any directions with respect to the format of their responses. [academic]

Finally, for some assessors, language control was a more stringent requirement than even knowledge of the topic:

I can work with someone who has a poor sense of content but not if they don't know how to use language.[13] [academic]

Through their evaluations and additional comments these professional engineers seemed keenly aware of what constitutes appropriate and effective technical communication, even if their views were not universally the same nor applied consistently. The goal now should be to tap their expertise and to instill this awareness more firmly in the novice practitioner as well.

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[13]However, not all assessors felt that good language was preferred over good sense. In personal conversation, several told me that as long as language was moderately adequate, they would prefer to work with someone who, in their words, "had a clue" about content and knew how to write a focused report that could be given to a client.

CHAPTER 5: DISCUSSION

The current research was able to draw on a pre-existing engineering report writing project for a number of diverse data sources for both quantitative and qualitative analyses. The first source was a set of technical reports ($N = 202$) written by undergraduate engineering students as the sole requirement for a compulsory course credit. A second set of data was provided in the form of evaluation sheets for these reports in terms of thirty criteria laid out within four main categories: Content, Organization, Format, and Language. The final results of the scoring had been assigned to the reports as performance levels, namely Distinction, Pass, Borderline, and Fail, and these constituted the students' grades for the course. Further information was collected about the students through a survey about their demographic and academic backgrounds. This information allowed for a first-level division of the reports and their scores according to whether they were produced by NES or ESL students, as well as for subsequent analyses of their original scores for the Writing Project and the relationship of their background data to these scores. A subset of twenty reports written by 10 NES students and 10 ESL students was later submitted for assessment to a group of nine professional engineers, four from the university and five from industry. Their assessment generated several additional data sources: their scoring on the appraisal forms, which were copies of the original thirty criteria set with six additional questions about professionalism; their judgments about the mother tongue of each report writer; their comments on the appraisal forms according to category designations; and their comments written spontaneously on the reports themselves. A final contribution took the form of ad hoc letters and notes written independently of the research and submitted afterwards. A discussion of the results of the analyses of these components follows.

5.1 Discussion of Questionnaire Data

A short theoretical note on the analysis decisions relating to the analysis of the demographic data is in order. The decision-making process on how to formulate a brief but fairly comprehensive questionnaire by which to discover students' personal backgrounds, experience and assumptions that might relate to writing proficiency was both straight-forward and oddly complicated. The need for basic demographic information would seem to have been self-evident, yet it implied that certain pieces of personal data were important to the understanding and assessment of writing. Thus, there was a presumption here that writing proficiency is a result not just of linguistic and conceptual knowledge but of total experience. Furthermore, by asking for background details about such variables as mother tongue, knowledge of other language(s), citizenship, academic history and current status, and work experience, there was the expectation that some or all of these variables would turn out in some way to be related to the final scores given to the reports by the Writing Project team of markers and the post facto assessment of a subset of these same reports by professional engineers.

As Grant-Davie (1992) discusses so thoroughly, the selection and interpretation of data, along with the subsequent decisions about how to code data, are highly interpretive processes, especially in the investigation of text production or assessment. Even the decisions about which questions to ask are based on prior research, the literature review, and related discussions about possible findings and relationships. The desire to remain open-minded and flexible about interpreting the information has a satisfying veneer but may nevertheless be sabotaged by unacknowledged presuppositions on the part of the researcher. Thus, awareness of underlying assumptions must be maintained. This caution also applied to the work described here.

In any research, the division of data automatically classifies data at the same time. The same is true in this research. The desired

approach was to let the data fall into patterns without being pushed so that an assumption about the outcome was not formulated in advance of the research. Instead, it was expected that the objective tabulation and analysis of the responses would generate insights into potential relationships between a student's writing proficiency and his or her personal experiences.

5.2 Discussion of Evaluation Sheet Results

The first research question (in Chapter 1, p. 73) dealt with whether the results of NES and ESL undergraduate engineering students ($N = 202$) for the same technical writing task were comparable. The questions on the evaluation sheets for the Writing Project had been devised as criteria to both assist the students and help the markers further guide the students who submitted their compulsory first drafts for such feedback. The WTS markers for the Writing Project reported[1] that most students ignored the importance of the draft stage and chose to correct only superficial errors, or had deeper problems with the writing task as a whole that may have reflected a more profound lack of understanding of the genre and quality of the work required.

Prior to the analysis of the data, it was expected that NES and ESL students would differ markedly in their results on the Writing Project, not only in their overall standing, but in satisfying the specific criteria outlined for them. Only part of this assumption turned out to be valid: The NES and ESL students in the study did differ on key criteria but in such a way that their overall results were similar. NES students were stronger in the areas of content and language control. The ESL students' parity in total scores rested on their ability to manage the appearance of appropriate technical communication rather than on their control of more substantial aspects of the topic or on linguistic strength.

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[1] Janna Fox, Carleton University, personal communication, September 1995.

This ability may serve to artificially boost marks and help ESL students pass university course requirements but is ultimately inadequate when ESL engineering students are judged specifically on report writing, as confirmed by the return rate of ESL students on co-op programs, by their supervisors' reports of ESL students' failure to satisfy, and by the high number of ESL graduates taking professional accreditation exams who are judged to be inadequate writers. Professors involved in co-op programs (e.g., P. Van der Pugh, Carleton University, personal communication, June 1996) have reported the dissatisfaction felt by high technology employers with the writing capabilities of their placement students, a large proportion of whom are ESL students. And the Association of Professional Engineers of Ontario (APEO)[2], the accrediting institution for that province, has been working on ways both to more accurately assess the writing capabilities of their candidates through their exam process and to deal with the overwhelming evidence of poor writing proficiency of many of the applicants, especially those with ESL backgrounds (L. Fogwell, APEO, personal communication, December 1994 to August 1995).

5.2.1 Performance Level Scores by Category

The analysis of the students' results on the Writing Project suggested a strategic difference in how NES and ESL students approached the writing task, not solely as a statistical but also a qualitative observation.

Most of the ESL writers in this study followed the rules of the writing task explicitly, as is evident from the types of questions in which they gained their scores: They polished the surface but faltered in substance. When NES and ESL students fell into a low performance level, the reasons for their lack of success may have been related to any number of factors that are not specifically linked to second language issues. Either group may have suffered

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[2] Since the initial period of this research, the association has renamed itself simply as PEO: Professional Engineers of Ontario.

from a reduced ability to process instructions, from ignorance of or unfamiliarity with the subject matter, from a limited understanding of the terms or requirements of the task itself, or from a low level of comfort with using language to demonstrate understanding. However, as this research has shown, the ESL students who did poorly manifested these limitations at different points than did NES students.

It is the inconsistency between NES and ESL students' distribution of scores through the performance levels that signals attention here. ESL students consistently got higher scores on criteria relating to explicitly required but more superficial components (especially but not only within the Organization category) so that their overall results were similar to those of NES students. The proficiency level may have been the same for NES and ESL students, but when the groups were compared within any one level, the means to achieve this proficiency were different. Strengths in terms of structure or the explicit inclusion of certain items helped compensate for weaknesses in conceptual and linguistic competence. This pattern was particularly evident as the performance levels declined and ESL students in the Borderline and Fail levels, in particular, boosted their scores by adhering more successfully to the criteria for Organization and Format.

Part of the reason for the scoring patterns described may be strategic: It may be that ESL students were more likely to focus attention on controllable features such as organization and format in the preparation of their reports precisely because they did not feel entirely comfortable with the topic or the language required to express their ideas.

In an academic situation, the strategy of controlling the image aspects of an assignment often has a positive influence on the overall results (Morris, 1998). As students demonstrate their increasing maturity and understanding of expectations in the areas of organization and format, any deficits in their full comprehension or presentation of content may be tolerated or perhaps not as easily

discernible. The ESL students in this study were not functioning in an ESL context but rather were studying in the same undergraduate engineering context as their NES classmates in the Writing Project. However, the ESL engineering students may have learned from prior ESL learning situations that properly managing aspects of organization and format can sometimes compensate for lesser control of content and language. To a certain extent this strategy paid off here for ESL students whose failing scores for some central (analytical) questions were boosted by much higher scores for other, more surface-oriented questions. In the working world, where the outward appeal and appearance of a piece of written text are understood to be givens, the response to ideas and the judgment of linguistic control may be more critical.

5.3 Discussion of Performance Levels Related to Demographic Data

It was anticipated for the current research that any differences in the assessment of technical engineering writing produced by native English speakers and writers who use English as a second language would not be simply the result of an obvious gap in language proficiency but the influence of other variables in the background of both groups of writers. An analysis was undertaken in order to ascertain whether the demographic and other background variables highlighted through the questionnaires in any way influenced the performance levels achieved by the NES and ESL engineering students who wrote the reports.

There are several interdisciplinary focuses of this research. One focus is the field of tertiary education in Canada, specifically with reference to undergraduate engineering students. Another focus includes the sociocultural and linguistic issues related to English-as-a-second-language learners. The second research question (Chapter 1, p. 73) suggested that writing produced by ESL students would be different from that produced by NES students and that some of that difference may be attributable to non-linguistic variables, especially in academic and sociocultural areas. The aim

was to identify possible patterns of relationships for the sample population as a whole and for NES and ESL specifically, rather than to simply determine correlations between these variables and their scores on the Writing Project. An additional purpose was to create a rich description of these two groups that would inform pedagogical considerations in writing for specific purposes. The statistical findings and descriptive observations about the degree of influence from background variables on the students' results on the Writing Project were presented in detail in Chapter 4. Following is a discussion of these analyses, with reference to explanations from the literature that might apply.

5.3.1 Demographic Variables with No Statistical Relationship to Performance Levels and Low Descriptive Interest

Age. ESL students were older than NES students in this sample by almost the length of an undergraduate degree program (i.e., ESL students' average age of 23 years to NES students' average age of 20 years). However, there was no statistically significant relationship between their mean ages and the results obtained on the Writing Project. The higher mean age of ESL students is partially explained by their having delayed or repeated the Writing Project and in some cases because of their making a second or more attempt at the task. Thus, the ESL students' success in the project may be partly a factor of rehearsal rather than maturity.

Knowledge of other languages. The question about whether the students could speak other languages was asked in order to ascertain whether students with access to concepts and reasoning ability in one or more other languages would score higher on a writing assessment than students who were unilingual. It was felt that increased linguistic ability might confer a measure of flexibility or capacity to deal with the requirements of writing in English, whether the writer were an NES or ESL student, but this feeling was not supported, primarily because the cell sizes were too small to make meaningful comparisons.

Work experience. The question about previous work experience (specifically, any work related to technical or engineering areas) was added to the questionnaire to see whether students who have some understanding of the workplace as a specific cultural milieu would also have better results vis-à-vis writing requirements. The findings showed that very few of these students reported having work experience; thus this aspect of their personal experience was not likely to exert much influence (statistically) on their overall results. The fact that more ESL students in the Distinction level had work experience was only suggestive, not definitive, about the influence of work on their higher results. Other variables may have affected the answers here with regards to work experience and proficiency levels. For example, the ESL students in the Distinction group had an average age of 23 years, ranging from 17 to 27 years. This was higher than the average for the whole population (20 years) and higher than the average age for the NES Distinction students (20 years. Of these seven NES students, six were 19 and one was 27 years old. In both groups, all respondents were making their first attempt at the project; thus, prior experience in doing the project could not be considered an intervening factor. However, three of the seven ESL students with Distinction were in their third or higher year of study, which could also partially account for both the success in terms of performance level and the work experience.

Citizenship status. The citizenship status (i.e., perceived level of commitment to staying in Canada) was reviewed. The large number of foreign-born ESL students who reported landed immigrant and naturalized citizenship status confirms the fact that the majority of these engineering students will continue to invest in academic and work careers in Canada.

5.3.2 Demographic Variables with Some Statistical Relationship to Performance Levels and Moderate Descriptive Interest

For this second set of variables, the descriptive patterns that emerged from the analysis were more interesting than the minimal or even moderate strength of statistical relationships.

Mother tongue and regional representation. In the ESL group of students, respondents from Asia or South Asia constituted the major language/regional portion. Besides English, the predominant languages of the students were Tamil, Chinese (Mandarin and Cantonese) and French. There was no statistically significant relationship between mother tongue and scores or between regions of origin and scores, mostly because samples sizes were too small for such specificity. However, the under-representation of Asian and South Asian students at the Distinction level (relative to their higher ratio overall) and over-representation at the Fail level makes one speculate about possible cultural bases for these differences. Middle East students, in contrast, were relatively over-represented at the upper performance levels. Anecdotal evidence and personal teaching experience could point to a higher dependence on stronger oral skills on the part of Middle East students to support their writing in comparison to the generally weaker oracy levels of Asian and South Asian students (Carrasquillo & Rodriguez, 1996), but this is purely speculative given that there was no assessment of oral language in this study. One could just as well speculate on introversion and extroversion as underlying factors in this regard, in terms of cultural preferences for learning styles (Horning, 1993).

Time in Canada. There seems to be some validity in the notion that an English-speaking student who was born in Canada should attain a higher level in a language-based task than a non-Canadian-born ESL writer. One would also expect to find a relationship between an ESL student's longer residency in a second-language culture and an increased ability to succeed in a writing task that required linguistic and cultural understanding, in particular when education was undertaken in the second language as well. For all intents and

purposes, the ESL respondents not born in Canada but with more than 14 years living in Canada could be considered almost NES-like and were quite likely to have been fairly well acculturated to the educational system, since all of their schooling would have occurred in Canada regardless of which language (English or French) they studied in. Considering the mean age of the ESL respondents born abroad (23 years), any student who averaged more than six or seven years' residency in Canada would have come into the country as a young to middle-aged teenager and would therefore have also become acculturated to some degree and be likely to manifest the same kinds of successes and failures as other (NES) Canadians competing to enter university. Those with six or fewer years in Canada would probably have had to enter the secondary system mid-stream, sometimes regardless of the high school level attained in their native country. One could assume that these anomalous secondary school experiences may have affected both linguistic and academic adjustments in some way and would be reflected in the scores.

Despite these apparently logical assumptions about a relationship between residency period and academic success, however, statistical analysis showed no relationship between these variables when total scores were considered. When the average scores for the 81 non-Canadian-born ESL students were associated with the number of years in the country, there was a small but steady rise in scores as the number of years increased (from 68% average for one to two years, to 73% average for eight years) but this suggestive pattern of consistent improvement with increased time in the country did not prove to be statistically significant.

The number of years in Canada of the foreign-born ESL students of the combined Distinction and Pass groups ($n = 66$) showed a mean of 5.5 years. This is similar to the average years of residency of successful ESL students in the massive study undertaken by Virginia Collier (1987, 1999/2000, and also reported in Olsen & Leone, 1994). The Collier research showed that the length of time necessary for ESL students to compete equitably with

native-English-speaking students was between five and seven years, even with so-called "good" and "most effective types of programs" (Olsen & Leone, 1994, p. 1). This suggests that a minimal number of years (on average, six years) is required for both language proficiency and acculturation to be satisfactorily complete. Thus, the success of the Pass-level ESL students in the Writing Project may be partly a factor of their having had the time to acculturate to Canadian academic expectations before they were required to write the report. Linguistic proficiency alone was not the prime factor in attaining their Pass performance level.

A shorter length of stay seemed related to a poor result of Borderline or Fail, although the numbers were respectively lower in each case. The longer foreign-born ESL students had lived in Canada, the fewer there were at the Borderline or Fail levels, which supports to some extent the data on the modes (most frequently reported number of years) which suggested these were lower for the combined Borderline and Fail levels than for the combined upper levels. Since almost 80% of the non-Canadian-born ESL students in this research had been in Canada less than eight years and 68% for six years or less, they would, in Collier's (1987) terms, be considered to be in transition to equity.

The descriptive findings in this research on ESL students' length of stay, as related to their length and type of high school experience, support to some extent the claim that longer residency seems to be desirable for success. However, the lack of any statistical support leaves only the qualitative patterns on which to base any interpretation. Certain aspects of their experiences such as duplication of the high school experience abroad and in Canada, high school taken in English abroad, higher average age, and even gender may have had varying degrees of influence on their results. The complexity of these variables in terms of their possible relationships did not allow for definitive conclusions about the extent of their influence within the limits of this research. Nevertheless, a descriptive understanding of the ESL students'

educational backgrounds showed that these should probably be taken into account in the analysis of their results on the Writing Project.

Canadian high school experience. Students who complete their secondary education in Ontario typically have had five years of high school rather than the four years normally the case in Canada[3] Many ESL students not born in Canada frequently take advantage of the OAC (Ontario Academic Credits) program offered in that fifth year in order to ground themselves academically or just linguistically for one year before entering university in Ontario. This is important in terms of this research since more than two-thirds of the ESL students reported having had at least one year in the Ontario educational system (mostly for the OAC program) and could therefore be assumed to have had at least a minimal exposure to aspects of Canadian high school education before beginning their university program.

The high school experience of any undergraduate university student is likely to have a strong and immediate influence on their success in a degree program. The expectations held by most undergraduate engineering programs in Canadian universities are common and therefore accessible to the same degree to most Canadian high-school-leaving students. Whether this understanding also applies to foreign-born ESL students is not clear. But most (77%) of the foreign-born ESL students in this study had received the majority of their secondary education outside Canada (i.e., had taken between zero and three years high school in Canada). Many ESL engineering students had therefore studied both in and outside of Canada, with whatever advantages and drawbacks that this variability in educational experience implies. In the case of one group of ESL students, the time in secondary school was inordinately long, in some cases ranging up to eight full years, with overlapping experiences abroad and in Canada. Some other ESL students had acquired linguistic, if not cultural, familiarity with English prior to their arrival. Given the evidence of time spent in Canada of ESL

[3] This five-year program in Ontario will be phased out by the year 2004.

respondents both with and without Canadian high school experience, it appears that a period of acculturation along with prior Canadian academic experience can promote university success. The system seems to be more accessible to ESL candidates if they have experienced some form of academic acculturation.

It may be important to understand the consequences of this need for academic acculturation for ESL students who enter university in Canada without any kind of prior Canadian school experience. One consequence relates to the effect of their language proficiency on their access to academic programs. The second consequence relates to the nature of the language screening instruments themselves and what they imply about the academic readiness of ESL students. Non-native speakers of English who have the subject matter credentials (in the form of grades) to get into a university program are routinely further screened for admission on the basis of their English language proficiency. Standardized commercial tests used by university administrators for this purpose include the international Test of English as a Foreign Language (TOEFL) or the Michigan English Language Assessment Battery (MELAB). Most commonly, these instruments focus on testing the student's knowledge about discrete point aspects of English, or at best, chunked segments of a diverse sample of language items. Thus, it is possible for ESL students to be successfully admitted into their degree programs on the basis of a language proficiency test which requires them to demonstrate their knowledge about the language.

These tests, however, do not generally present the English language in such a way as to ascertain the full range of academic competence of the test-taker (Carrasquillo & Rodriguez, 1996, p. 31). The higher-level skills normally learned through full high school programs in Canada and the strategic competence required for university coursework are not emphasized in these language tests. Thus, these same ESL students could do poorly or even fail in their university programs because of their limited proficiency in managing real, task-based academic writing assignments in English.

They are accepted on a par with ESL students who have been in the Canadian secondary system[4], but they are not necessarily as informed about the assumptions or expectations about Canadian academic requirements and strategies. There is usually no test[5] for cultural or educational awareness for ESL applicants which would provide a broader assessment of their academic readiness beyond language proficiency. Not all ESL students who are admitted to university on the basis of these discrete-point language tests do poorly. However, the assumption that demonstration of language proficiency is sufficient to predict academic success may be ill-founded. Accepting ESL students into degree programs should also mean accepting the responsibility to help them succeed.

The Collier study (1987) asserted the relationship between prior experience and number of years of high school, and underscored two major findings. The first was that long-term advantages were most significant when students had received a strong cognitive foundation in their mother tongue. (Given their ages, this advantage can be assumed for ESL students entering English-speaking universities and for those accepted into the engineering programs under study here.) Collier's team of researchers found that growth in all three areas of academic, cognitive and language development was necessary for adequate English language proficiency and academic achievement. Secondly, Collier emphasized that sociocultural processes can influence this growth.

If we extrapolate this information to the university setting in general and to ESL engineering students in particular, it would be

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[4] In the university in this study, ESL students who have taken at least four years of high school in English or were students of Anglais in the Quebec secondary system are exempt from a test for language proficiency, regardless of their actual ability in the language.

[5] At the university referred to in this study, the CAEL (Canadian Academic English Language) Assessment assesses notetaking, lecture and reading comprehension skills as well as writing rather than students' knowledge of discrete-point linguistic features. It would have placed advanced ESL students still requiring further language training into the appropriate credit ESL course even while allowing them to begin their engineering program. However, the students in this study were not concurrently enrolled in ESL courses.

logical to conclude that students who enter their degree programs with a large proportion of their prior educational experience in Canada are more likely to do well than more recent arrivals. Most of the ESL students in this study had at least a year of Canadian high school, but a single year may not be sufficient for comfortable acculturation in all aspects of academic achievement, including writing. Research on the academic success rates for ESL students in one Alberta school board (Derwing et al, 1999), for example, suggests that ESL students who emigrate to Canada in their early or mid-teens do not catch up easily with their NES counterparts. Instead, their school-leaving and non-completion rates are significantly higher, even when there are ESL support classes available. All too often, eligibility and subsequent funding for English-as-a-second-language courses are cut at an arbitrary year or at a specific school-leaving age, regardless of the student's length of time in the system. Sometimes students are forced to leave high school, regardless of a continuing need for language training, in order for the school system to maintain success quotas. Even those who graduate are not always as well prepared as a longer period of acculturation plus proper ESL training would have made them. Derwing et al's research suggested that being in the Canadian education system longer, and with adequate ESL support, should improve writing performance. The ESL engineering students in this study who were in the lower performance levels showed a lower average number of years in the Canadian secondary school system. However, there was no statistically significant relationship between ESL students' scores on the Writing Project and their years in high school, due mainly to the numbers of ESL students who spent so much of their lives in Canada, and to those who had unusual patterns in their high school experience vis-à-vis the progress of NES students through the Canadian educational system.

Engineering programs. NES and ESL students were not proportionally represented in the six engineering programs covered by this research. Mechanical engineering, for example, had more NES students while Civil had a few more ESL than NES students. NES

students seemed to favour some programs like Aerospace and Environmental, while ESL students seemed to prefer the currently very popular fields of Electrical and Computer Systems, both of which generally enjoy high registration in their programs. Computer Systems is also a fairly math-intensive program which tends to require students to write more software and hardware programming (i.e., text interwoven between computer instructions) rather than longer report-style written assignments. With technological specialization in engineering there is an explicit emphasis on programming and mathematical skills in the hiring process and for subsequent advancement in a career. The need for writing proficiency is often left unstated in the recruitment and application processes.

The reasons for program selection were not explored in the questionnaire; however, personal experience and discussion with ESL students could favour the conclusion that many ESL engineering students go into the field in the first place because of their strengths in mathematics and computer programming in comparison to their literacy skills. This interpretation has been supported with similar findings by others who have taught or otherwise been involved with ESL engineering students (i.e., N. Artemeva, J. Fox & S. Logie, Carleton University, personal communication, 1999). There seems to be a perception held by ESL students that Electrical, Computer Systems, Mechanical, and to a lesser extent Civil engineering are more math-heavy, while the other types of engineering programs are more text-based. This is not, of course, the case; most engineering programs require both mathematical and extensive writing skills. Language logic remains a fundamental requirement in engineering, with its problem-solving orientation and explicatory functions in its writing.

The difference in preferences may be most apparent in the program of Environmental engineering, which is a relatively new specialization and is not taught as a separate engineering discipline world-wide. The number of students in this study was also small,

with only twelve NES students and three ESL students taking this specialization; all of the latter were in the Pass level. The native languages of these three ESL students were not among the mainstream in this research study, namely Setswana (spoken by the male student), Gujarati and Portuguese speakers (both female students). The first student, from Botswana, had been in Canada less than two years, but had taken all five years of his high school in English. The student from India had lived in Canada for fifteen years and the Portuguese speaker had been born and fully educated in French in Canada. The personal histories of these ESL students in Environmental engineering were thus very similar to those of NES students, which may explain their interest in this new field not usually selected by ESL students. This low interest in Environmental engineering was also a finding in the pilot study, with similar representatives in the types of students.

Given the environmental focus of the Writing Project on the crisis-level infestation of zebra mussels in the Great Lakes, it seems odd that students in Environmental engineering had any difficulty with the topic even if other aspects of report writing were not fully managed. The twelve NES students in Environmental engineering distributed across all performance levels. The exclusive Pass-level results by ESL students in this program may be due in part to the fact that two of the three ESL students were females (see the discussion above on gender differences in adhering to criteria) and had lived in Canada all or most of their lives, thus minimizing the interference of their mother tongue in this writing assignment and gaining from increased cultural and academic experience.

NES and ESL students' scores did not vary significantly by engineering program in terms of the specific questions they had difficulties with. However, students in certain programs differed in the kinds of questions that were noticeably problematic. This may have been partially a factor of the language groups that comprised

each type of program as, for example, the large number of Tamil-speaking students in the Electrical engineering.

5.3.3 Demographic Variables with Stronger Statistical Relationship to Performance Levels and High Descriptive Interest

The third set of variables that were analyzed in terms of possible relationship to the performance levels showed stronger statistical relationships or had high descriptive interest.

Gender. The uneven distribution of males and females in this study duplicated the findings of the pilot study. Although there was a somewhat stronger preference for engineering on the part of ESL female students than there was by NES female students, the field is essentially male-dominated. In terms of their performance levels, NES females were distributed over the four performance levels in a similar pattern to their male NES counterparts. ESL females, on the other hand, scored exclusively at the Pass level, unlike the male ESL students who scored across the performance levels.

A combination of tendencies may have been at work here which help explain the good results for the ESL female students. This higher level of performance for ESL females may be partially due to the possibility that once accepted into a university program in what for many would be a non-traditional role, ESL female students work harder to satisfy their engineering requirements, including this Writing Project. This is inherently unverifiable, however, so must be excluded from consideration. There was also a suggestion that maturity may have been a factor in their higher scores. The four-year difference in average ages between NES females (19 years) and ESL females (23 years) resembles the length of an undergraduate degree program, which suggests a longer time for academic maturation and subsequent improvement in writing. But there was no statistical significance to support a maturational suggestion, despite the fact that some female ESL students were older and more of them were enrolled in a higher year of study compared to NES females. This leaves only a description of their distribution pattern

in performance levels and question scoring profile upon which to base a cautious interpretation of their success. A clear connection between maturity and writing proficiency could not be claimed by this study.

Another possible reason for the higher level of success by ESL females may be similar to that explaining the general ESL students' results, namely the emphasis on following presentation guidelines in the Organization and Format categories, such that any deficiencies in presenting original ideas, outlining recommendations or controlling language were mitigated by better management of report features that enhanced its overall order and appearance. This interpretation was supported by the types of questions on which ESL students gained higher scores, i.e., ones which were primarily related to the inclusion of vital components rather than quality of analysis. This adherence to guidelines also brings to mind the research on rule-following by ESL students (Morris, 1998), similar to the more careful attention to instructions paid by female students than by male students. In the Morris research, when ESL females were assessed for writing, they tended to follow the rules regarding surface features and guidelines more closely than did ESL males such that parity in proficiency was skewed by a reward for adherence (Morris, 1998). ESL females in the Writing Project could have earned their higher Pass levels (compared not only to NES females but to ESL males as well) primarily because they had followed the criteria more closely and self-edited more rigorously. This is in fact borne out to some extent in the current research by their tighter distribution into the Pass level alone, their higher scores overall, and their markedly higher scores for the kinds of questions discussed above (i.e., organizational, non-conceptual) compared to the answers for these questions by their male counterparts, as seen in the Results Chapter 3. Morris points out, however, that success in following rules must not be interpreted as proficiency in language (Morris, 1998, p. 236). Furthermore, as she cautions, there are dangers inherent in suggesting that conformity to rather superficial aspects of a task be required, since it not only

stifles creativity (relevant to the low scores on the question about original solutions for ESL female students in this study) but could mis-lead in the evaluation of actual proficiency. Even worse, rigid classroom-based behaviours which are rewarded may constrain the full development of true proficiency relevant to their fields of study (pp. 236-238). One cannot, therefore, claim that ESL female engineering students were better technical writers, merely that they appeared to be better adherents to the specified criteria, especially those relating to formatting and organization.

Year of study. The findings showed that far more ESL than NES students delayed doing the required Writing Project until their second or even later year of study at university. Others were attempting the Writing Project for a second or more time (see Number of Attempts below) after failing the first or subsequent attempts. It seems that for some ESL students the technical writing condition embodied by the Writing Project was hard to satisfy without a great deal of additional effort. At the very least, the requirement was perceived to be threatening and therefore put off for as long as possible. Three of the seven ESL students who attained a level of Distinction were in their third year, which suggests they may have benefited from increased exposure to a variety of engineering writing tasks and were more acculturated to the professional selection and presentation of data.

Number of attempts at the Writing Project. The difficulty of this Writing Project for ESL engineering students was further confirmed by the more numerous attempts they had to make at the task in contrast to the NES students. Since a larger number of attempts by ESL students was also a finding in the pilot study, it further supports the fact that the writing readiness of ESL students is a persistent concern that must be dealt with either prior to university admission or immediately upon acceptance into a degree program if they are to compete and graduate on a par with NES engineering students.

To summarize up to this point: The findings showed that ESL students appeared to score on a par with NES students on the Writing Project but that the road to this parity was complex and sometimes the result of intervening factors. The ESL students' results had been achieved as a consequence, to some extent, of their being older, spending at least as much or more time in high school as the NES students, making more attempts at the project, and even delaying the writing task till a more senior year, by which time their discursive maturity and content knowledge may well have been strengthened. The ESL students' performance as engineering students was, in many cases, a hard-won success.

5.3.4 Kinds of Writing Selected by NES and ESL Students

The last part of the questionnaire asked students to check off the kinds of writing they thought they were doing in their engineering programs. The kinds of writing selected by NES students were not taken as norms; there was no assumption in the study that native English speakers would have any clearer sense of genre than ESL students would. It was felt important to ascertain any difference in perspectives. A number of discrepancies in their perceptions of writing tasks are discussed separately below.

NES and ESL students produced a fairly similar rank order of the kinds of writing selected. A clarification of the most popular kinds follows: The highest ranked kind of writing was *lab reports*, a familiar constant to students in all undergraduate engineering programs. However, as Kalmbach's (1986) study shows, doing lab reports does not necessarily prepare students for engineering writing, so the high ranking of this item in being selected is not necessarily indicative of these student's ability to write lab reports. The frequency of selecting *exam short answers* and *1-2 sentence answers* reflects the quiz- and test-based evaluation system that predominates in engineering programs. The fourth-ranked kind overall (but third for ESL students) was *short reports*. It is possible that some students mistook *short reports* for *lab*

reports, but since this was not verifiable this interpretation is only speculative. Finally, most engineering students in first or second year do not generally write *proposals*, but this was a writing requirement added to a Drafting course at the university a few years earlier simply to assess how students could focus data, solve a problem and present it in proposal format. Therefore, for a lot of the students, writing a simple proposal was a fairly recent experience. Since it also required a covering letter, the relatively high percentage of students who ticked off *business letter* could also be explained. NES students selected these two items more often than ESL students in the same programs did; this may be because the ESL students did not recognize proposals and business letters as valid types of engineering writing.

ESL students tended to select more kinds of writing and at a higher rate for each kind than NES students did. This may indicate either a lack of discrimination between genres or a desire on the part of ESL students to be thorough in listing their writing tasks. The evidence suggested that the former was the reason. For example, although ESL students selected *short reports* more often than did NES students, they also claimed to write long reports and short and long essays more than did NES students. In addition, ESL students picked *assignment short answers* and *1-2-sentence answers* at a higher rate. These kinds of writing occur typically in mathematics, Electrical and Computer Systems courses in which formulaic or code-based data is woven together with short textual explanations. The fact that there were more ESL students in Computer Systems and Electrical engineering may offer a partial explanation for this selection pattern. There were also generally similar writing tasks required by all engineering programs and certainly no difference between what NES and ESL classmates had to do within each. The difference, then, lay in the ESL students' perception of what they were doing and their tendency to both over- and under-select kinds of writing compared to the selections made by NES students in the same engineering programs.

Part of the difference in the ESL students' understanding of the kinds of writing was apparent in their distribution of choices over the performance levels. NES students reported the kinds of writing in a generally consistent pattern across their performance levels, i.e. selecting the same kinds of writing but at decreasing rates as the performance levels declined. ESL students, on the other hand, selected the kinds of writing more randomly and much less consistently as their performance levels declined. It is clear from the patterns in the selection of kinds of writing showing the widest divergence between NES and ESL students choices (10% difference or more), that students in the Fail level had the least perception of type and/or use of kinds of writing, while those in the Distinction category had both a different sense of what kinds of writing there were and which ones were commonly used in engineering programs. The higher proficiency level of those with Distinction at least suggests that this group's perception was closer to the accepted norms of engineering and could therefore be considered a standard by which to compare the other answers. The selection by even Distinction-level ESL students of kinds of writing that are not generally done in engineering showed that their sense of genre differed markedly from that of Distinction-level NES students. The difference may rest partially in the fact that the ESL students who were given Distinction levels from the Writing Project markers were almost entirely in Electrical engineering, with two in Computer Systems, whereas the NES Distinction students were spread a bit more evenly over the programs with the exception of Electrical. Four of the seven ESL Distinction students were in the second or third year of their Electrical and Computer Systems programs, generally considered to be less writing-intensive and more mathematically-oriented. The ESL Distinction students may have gained more experience with certain kinds of writing tasks but these may not have been the kind required by this Writing Project. The ESL Distinction students' selection pattern therefore contrasted to that of the NES Distinction students who were spread over a wider range of programs and seemed to be selecting more appropriate kinds of writing. A weak sense of the genres they are

writing even now in their programs may reduce some ESL students' opportunities to learn the appropriate writing conventions that will be required of them later as practising professionals.

In comparison to those in the higher performance levels, all students in the lower performance levels not only tended to under-report the kinds of writing they thought they did in their engineering programs but also made fewer distinctions between the types they did select. This was particularly notable for the ESL students who failed and whose selection pattern showed little discrimination among the kinds selected compared to that of the NES students who also failed but who nevertheless demonstrated more discrimination and variability in their choice of kinds of writing. Given the similar numbers of NES and ESL students in the lower performance levels, this was a significant finding. It is apparent from these results that even ESL students who scored well on the Writing Project were not necessarily as familiar with the types of writing required by engineering undergraduate academic work (e.g., lab reports or short reports rather than essays), while ESL students who scored poorly on the Writing Project simply did not differentiate or even perceive the genres required. This aspect of genre recognition is discussed in Paltridge (1997) in his presentation of frame theory to the problem of defining particular genres:

> The key to a solution to this problem it will be argued, lies in the notion of *prototype, inheritance* and *intertextuality*, within the context of discourse production and interpretation; that is, the extent to which an instance of a particular genre is typical of the particular genre, the extent to which qualities or properties are inherited from other exemplars of the particular genre, and the extent to which a text is recognized as an instance of a particular genre in that it recalls other previously encountered instances of the particular genre. (Paltridge, 1997, p 47, emphasis in the original)

Poor language proficiency thus cannot be seen as the sole nor perhaps even the primary cause for some ESL students' failure to

write satisfactorily. Limited prior exposure to the genres appropriate to their academic programs may have also played a role.

Analyses of the selection of kinds of writing according to the students' engineering programs also revealed both inappropriacy and inconsistency in the choices made by ESL compared to NES engineering students, which suggests that simply being in the same engineering program was not adequate preparation for technical writing. The difference in selection patterns suggests a prior influence on the understanding of genre by these undergraduate students. The consistency of the NES students' choices, regardless of their performance level or engineering program, seems to confirm the influence of high school experiences in which genres would at least have been labeled if not practised. ESL students who had not benefited from such an exposure to academic practice in these genres, or at the least, discussion of their typology, would not have internalized the differences in genres to the same degree. Since the selection patterns of Canadian-born Francophone students and of those foreign-born ESL students who had lived in Canada longer more closely resembled those of NES students, there seems to be some support for this interpretation.

Comprehending the nature of the writing one does is not only a function of educational experience but also an indication of task differentiation. Since it is highly unlikely that most of the ESL students were doing different kinds of writing tasks in their courses than their NES classmates, their response concerning, for example, essays versus reports, suggests these ESL students had not as yet made a distinction between these two major academic genres. It may also be that engineering students in general do not value the kind of writing they do, even if they value the task as part of learning engineering (Kalmbach, 1986).

The selection pattern by ESL students also gave the impression that they thought the writing tasks they were doing were long, given that many more ESL than NES students indicated that they were writing long reports as well as long essays. The task may have

seemed longer because it was harder for them to do. Part of this disparity in perception could also have been due to a different cultural understanding of writing, as shown by the distribution of selections by the majority language groups represented here. Canadian-born Francophones had some similarities to NES students in their selection percentages for kinds of writing. Chinese-speaking and especially Tamil-speaking students, on the other hand, were noticeably different in over-selecting genres, such as short essays or short paragraph answers, not so highly ranked by the NES or Francophone students. The ability to identify genre, in other words, does seem to benefit from cultural and academic exposure.

An analysis of the relationship of performance levels to demographic backgrounds and experiences produced a mixed and complex description of suggestive and underlying patterns to explain the Writing Project results of the NES and ESL engineering students in this study. The extent to which these variables were present in the considerations given to their writing by the engineer assessors will be discussed in the next section.

5.4 Discussion of the Assessors' Evaluations

By themselves, descriptive studies of how students write do not tell us enough about how effective their writing is. The effectiveness of the technical writing of a novice must be judged by its acceptability to those already recognized as experts in the same profession who would normally comprise the audience within the intended area of specialization (Spilka, 1993).

The original intention behind asking professional engineers to assess student engineering reports was to ascertain: a) whether there would be any differences in their scoring patterns on the appraisal forms compared to the students' original results on the Writing Project, b) whether these assessors' evaluations would be different for NES and ESL students' reports, and c) whether the assessment of the technical writing produced by these engineering students would be similar for academic and industry engineers or

would show differences based on their own professional focuses. As in so many aspects of this research, the answers were complex. A discussion of the components of the professional engineers' contributions is necessary to clarify the answers.

The nine assessors were all writers who needed to produce and respond to text as part of their professional duties. As practising engineers, they had the experience and the insight to assess whether a document met or failed professional expectations. The four academics were obviously more familiar with dealing with student writing, although one could make the case that professors of first and second-year students seldom receive extended samples of technical writing, and few judge technical writing per se on a regular basis, if at all. The five engineers in the workplace setting (the industry assessors) were more familiar with the immediate demands of the market, were more often required to write directly for clients, and were seldom, if ever, involved with student writers unless connected to a co-op program. Their expectations of novice writing would be directed primarily towards writing produced by graduated engineers. Therefore, by asking both academic and industry engineering professionals to respond to the reports written by undergraduate engineering students, it was possible to highlight those features of technical writing that were acceptable to the profession as a whole.

All the assessors were fully aware that they were reacting to student text produced by novices only beginning their initiation into the discipline. All assessors knew that the engineering students in the sample subset would never see the results of their evaluations. They were also aware that some of the student writers could be speakers of English as a second language (ESL). The assessors' responses could thus serve instructive as well as evaluative purposes.

This group of engineers represented a professional collective, not because they inhabited the same physical space but because they drew their assumptions and expectations from the same mental

framework. In Carolyn Miller's (1994) terms, they constituted what she calls a "rhetorical discourse community", one that excluded the other, the non-expert, as they recognized and reified their own membership in the discipline of engineering. These assessors confirmed their professional status through their judgments about writing, manifested by their confidence in determining the acceptability of the subset reports as exemplars of a professional engineering genre within the field of technical writing. As Miller defines it:

> A rhetorical community...is...a virtual entity, a discursive projection, a rhetorical construct. It is the community as invoked, represented, presupposed, or developed in rhetorical discourse. It is constituted by attributions of characteristic joint rhetorical actions, genres of interaction, ways of getting things done, including reproducing itself. ...[R]hetorical communities 'exist' in human memories and in their specific instantiations in words: they are not invented anew but persist as structuring aspects of all forms of socio-rhetorical action. Like genres, rhetorical communities 'exist' on a discourse hierarchy, not in space-time; they exist, however, at a much higher level of cumulation than genres. (Miller, 1994, p. 73)

That said, it is clear from both the quantitative and qualitative results of the assessors' responses, that the nine engineers were not consistent in their role as assessors. Even as members of a perceived common group, they were often distinct in their interpretation of its guidelines and in their manner of making those interpretations clear. As discussed by Gunn-Adam (1994), there is often a great deal of variability in response to novice writing by experts who bring different experiences and agendas to bear on their judgments. This aspect of expert response variability is the focus of the following discussion of the judgments made by the engineer assessors in this research.

5.4.1 Assessors' Quantitative Results for the Sample Subset of Twenty Reports

In the evaluation of the sample subset of twenty reports (comprising ten NES and ten ESL students' reports), both academic and industry assessors scored the NES reports more closely to the way these reports had been scored by the Writing Project markers than how they scored the ESL reports. However, industry assessors' scores were significantly different, not only varying from the Writing Project markers' and the academic assessors' scores for all twenty students, but also differing significantly in their assessment of reports written by ESL students compared to those written by NES students.

The academic assessors were closer in their marking pattern to the profile produced by the WTS markers who scored the same reports for the original Writing Project. This closeness may have arisen from their sharing more immediately available frames of reference (per Paltridge, 1997; or Swales, 1992), based on similar experiences. Industry assessors, on the other hand, showed a different profile in their scoring patterns and so, except for their agreement in the Format category, the two types of assessors were significantly different in their assessment behaviour when compared as groups. This suggests that if there was some common underlying concept about genre appropriacy available within their profession, it was not explicitly accessible, or not framed in the same way, for each engineer in this study. Each assessor purported to be able to judge the acceptability of a technical report as he applied the criteria presented in question form. Yet the interpretations and/or the value assigned to the questions varied, at times dramatically, among the individual assessors.

The academic assessors were operating more closely within expectations and assumptions specific to an educational context. Their responses to the written texts showed they saw these reports as serving a more epistemic function, demonstrating learning, than as practical or contributing to the profession (Dias et al, 1999). This

is supported by the fact that although the academic assessors were tougher on NES reports than they were on ESL students' reports, their profile of scoring for NES students' reports showed that the academic assessors ranked the NES reports fairly consistently at almost the same levels these reports had obtained in the Writing Project. The academic assessors may have scored the ESL reports somewhat higher than these reports had attained from the WTS markers, but the same academic assessors were also less consistent in their scoring profile of ESL students' reports compared to their consistency with NES students' scores. Evaluating the ESL students' reports therefore could be seen as more problematic for the academic assessors. This apparent difficulty in assessment further suggests that the ESL report writers were situated more weakly within an epistemic framework and so were looser adherents to the academic cultural norms than those applied by the academic assessors.

On the other hand, the apparently more lenient scoring overall by industry assessors of the students' reports may actually have been a blending of their impressions of the quality of the reports rather than a measure of their approval. With the exception of the only ESL student with Distinction, the industry assessors compressed their evaluations for both NES and ESL students' reports into a Pass level (including original Borderline and Fail reports). The industry assessors did not seem prepared to make a finer distinction between the reports they read. This may be a factor of their distance from the academic context and suggests a level of disengagement between academic and industry engineers in terms of their assessment of writing.

For many engineers in industry a particular text is only part of a document flow that may involve a collaborative team of writers who contribute to and edit the text at various stages in the drafting process (Bergmann, 2000; Rivers, 1989; Robinson & Courter, 1989; Winsor, 1996a). Thus, the industry engineers in this study could have been reacting to the reports merely as drafts in a longer chain of

document management, to be evaluated on an approval basis where a document was or was not ready to move on in the chain. Their scoring therefore served an input, rather than a marking, purpose.

When asked to transfer their scoring confidence about the reports to a hiring decision or to judge the professionalism of the student reports, the assessors were not apparently willing to be as tolerant. Few NES report writers, but even fewer ESL report writers, would be hired by these engineers. Overall, the assessors disagreed in their hiring decisions for all but one report writer, namely the NES Distinction level student, who presumably would have been quickly hired. In contrast, the ESL Distinction student, whose report had been scored in the same way as the NES Distinction report by each type of assessor, was not considered as employable. Thus, despite acknowledging that some reports had good qualities, the assessors were basically reluctant about hiring the student writers. This was shown in the inconsistency of their hiring decisions compared to their scoring decisions and especially in their reluctance to hire when ESL reports were considered.

Making a decision to hire someone on the basis of a written document is not entirely an artifice of this research. Judgments about actual or potential technical expertise are commonly made on the basis of a written text and not on direct interaction with the writer. Many companies rely on evidence of a candidate's ability to communicate effectively not only through the standard oral interview but also through a covering letter or a portfolio of written work. Clearly, the assessors in this research were not engaged in such a search, nor were these students ready for full-time employment. Nevertheless, making a hiring decision about students does become relevant when they are considered for work-study programs. There are a number of co-operative programs (for example, at Memorial University in St. John's, Newfoundland, or at Carleton University in Ottawa, Ontario) which require students who are still in mid-program to demonstrate appropriate writing skills through their reports on their work placements (Kreth, 2000) and

through simulated writing tasks involving proposals, memos, or brief letters in response to case studies. Often a co-op candidate's writing ability or lack of it has been a deciding factor in the initial decision to forward that student's name to the program, given that technical marks are normally competitively high for the few positions available. This scenario has many features in common with a hiring or other screening process in which an acceptable level of writing is required. The Association of Professional Engineers of Ontario, for one, includes an assessment of writing in its accreditation procedure and has failed candidates for poor writing even when technical knowledge was adequate (L. Fogwell, personal communication, December 1994). In these situations, the writing stands alone as a manifestation of proficiency rather than one in a series of learning opportunities. Therefore, the assessors' responses to the question asking them to judge the employability of the students in this study are revealing. They found the reports generally acceptable on the basis of the criteria they were asked to consider but apparently would not agree that this level of acceptability was sufficient for employment considerations. Furthermore, there must have been something in the ESL reports, many of which were deemed acceptable pieces of writing, which made the assessors hesitate even more about hiring ESL students compared to hiring NES students. This suggests culturally based characteristics in the students' reports, rather than solely linguistic features, may have influenced the assessors' decisions.

5.4.2 Assessors' Comments about the Subset Reports

The comments written on the appraisal forms and on the reports by the assessors were detailed in the Results Chapter 5. Given the very typical response to writing in the form of concerns, criticism or disagreement, it was not surprising that a majority of the comments written by the assessors were more negative than positive, both on the reports themselves and on the appraisal forms.

First, a remark about counting the responses: A simple tally of comments is not indicative of a reader's state of mind or general responsiveness to text. However, it can be argued that provocation by a text of any response by a critical reader can be taken as a clue to the text's general acceptability per se within a specific discourse setting. Since both sets of assessors understood the parameters of their reading task as well as the nature of the report writers' assignment, their responses as professional engineers to each report reflected both the assumptions or standards they held about engineering writing and the aspects of each text itself that they found noteworthy--or worthy of criticism. The more than 1800 written responses generated by these assessors on the appraisal forms and reports certainly seem to suggest a high level of provocation.

Both academic and industry assessors commented very specifically on levels of conceptual understanding and on language features that were problematic. Most expressed criticism of the writer's misunderstanding of the basic problem, naive solutions, poorly focused recommendations, and weak language presentation.

As a group, the industry assessors were more forthcoming with written responses; they were also both more generous in their praise and at times more biting in their criticisms. Academic and industry assessors alike revealed a strong sense of what technical documents should look like. The concept of appropriate technical writing brought out by the assessors' comments seems to be a common one. It rests in the central view that a well-written report maintains a sense of audience and purpose. Although the Writing Project was obviously a test of writing proficiency set within an academic course, there was an opportunity for the students to look beyond the marker-reader and direct their reports towards an actual, potentially important and interested audience. The instructions to the students had included the information that selected outstanding reports were going to be forwarded to Ontario Hydro for consideration as real solutions to the zebra mussel

problem and this in fact happened: several students were invited to make a presentation of their solutions to the provincial agency. Thus, the report not only served as an instrument to assess first-year engineering students' technical writing ability but also offered a real workplace reader and possible future employer, had the student writers made an effort to reach this audience. Most, however, stayed within their student roles and aimed their reports at a marking audience.

The assessors' views on technical writing further support the notion that content in a technical report must be firmly under control (with the aim of solving a well-defined problem) and presented in clearly organized text, divided by appropriately labeled headings. Conceptual clarity and proper formatting were seen to be related; a reader should not be confused nor allowed any room for creative interpretation (Beer, 1992). The assessors also expressed a preference for the order of report elements, preferring certain sub-sections (Introduction, Background, and so on) before others. The reasons given for the suggested re-organization included setting up the recommendations within a clear context. Yet some of the criticisms, especially those by industry assessors, flew counter to typical textbook or article recommendations about how to organize short report sections (Beer, 1992). The students in the Writing Project had been advised to place the summary and recommendations sections near the beginning before presenting background details or description of alternatives. This advice did not reflect the perceptions of these particular practising engineers about what should be done in a short report. These engineers' frames of reference (per Paltridge, 1997) were more specific to their own context. It is possible, for example, that the different fields of engineering represented by the industry assessors as well as their own writing experiences may have influenced the structural preferences outlined here. Industry assessors, in particular, expected a certain order of topic headings, primarily to present context and prepare them as readers. Students had been given a recommended list of major headings but it did not include the

executive summary which was expected by several industry assessors. It may be that the industry assessors were more used to writing as executives and that their work experience and roles as corporate engineers were stronger than their awareness of the report writing task as an academic assignment, i.e., they were not used to assuming this kind of academic role. Further, this consciousness of executive rather than pedagogical role could well have triggered specific expectations about report elements. A concern which predominated for industry assessors, for example, was the acceptability of the report to a potential client, e.g., "The student hasn't understood the topic and has made intellectual jumps. Such a report could never be defended to a client." Clearly, the ultimate criterion for acceptability is whether a document is transportable across audience barriers, and especially to a manager or to a client. The report referred to here was an original Pass level ESL report, yet this assessor was suggesting it would not pass in a professional environment where business interests and public presentation are as important as technical expertise.

Another example of an emphasis on a required element was the assessors' reaction to the lack or inappropriate presentation of a summary table outlining the alternative solutions to the zebra mussel problem. Many industry assessors' comments, especially, emphasized that it is common organizational practice in engineering writing to present a visual or graphic summary of the text information as a measure of completeness. The engineering students whose reports generated criticism on this point may not have had much prior experience in liaising textual and graphic data as inter-related elements of written work for the purpose of reassuring the reader.

In short, the assessors' collective sense concerning the generic characteristics of appropriately written engineering reports was very strong: Reports had to be focused, signaled, organized so that data were easily retrievable, and presented in accurate but spare language.

In terms of the assessors' ability to differentiate between NES and ESL students' reports, it became clear that students' use of language was an important factor, but not the only one in making this judgment. Poorly written reports, regardless of mother tongue, were more likely to be seen as ESL, although some assessors noted errors that they said were due to carelessness rather than second-language weakness. The industry assessors commented on language difficulties, especially in ESL students' reports, far more often than did academic assessors. Many ESL students successfully pass language assessment to gain placement into regular courses. The industry assessors' reaction to their writing, however, suggests that even ESL students who have been fully integrated into engineering courses may still produce written text whose linguistic quality continues to place them at a disadvantage relative to NES students, especially when assessed by those outside the academic system. This concern is not unfounded, as Zamel's (1998b) research has shown regarding ESL students still within the academy. In her study, some faculty appreciated the cultural diversity and various viewpoints of ESL students, but when expressing concerns,

> by far, the greatest concern had to do with students' writing and language, which faculty saw as deficient and inadequate for undertaking the work in their courses. I got the clear sense from these responses that language use was confounded with intellectual ability--that bad language and insufficient cognitive development were being conflated. (Zamel, 1998b, p. 250)

In addition, industry assessors often questioned the level of reading comprehension of ESL report writers, which suggests that the engineers had some insight into the basic processing skills and even literacy level of these writers. A focus on the relationship of writing to proficiency in reading was evident through the assessors' comments. For example, the statement, "Language control is good. The student appears to have read technical material in English, since the style of the report flows well" is interesting since the assessor

apparently saw good language and flowing style as at least partly the result of broader reading experience of technical material in engineering. Weaknesses in the reports highlighted by assessors were not always language-based, but also referred to appropriacy, to selection of relevant information and to interpretation of data, all of which are features of cultural and educational experience as much as of language mastery (Carrasquillo & Rodriguez, 1998; Geisler, 1994; Horning, 1993).

The assessors expressed a common and overriding concern for professionalism in all its aspects, namely content control relevant to the purpose of the report, clearly organized and well formatted text, and a proper sense of audience. This standard was applied equally to most NES and ESL students' reports. But the concerns about professionalism were not based on a peer, or collegial, review of the reports; the assessors did not seem to lose sight of the novice status of these report writers and so did not engage in response behaviour more typical of a peer review.

An analysis of the anomalies in scoring showed that for a few NES students' reports, at least, industry assessors believed that conceptual strengths could compensate for any organizational or linguistic shortcomings. This contrasted with the assessors' typical intolerance for poor language use in ESL reports even when the ideas in them were more or less adequate. Sometimes when reports were seen as professionally deficient in some way, the assessors made specific references to the possible ESL status of the writer, whether or not this was actually the case. Some reports which were viewed as off-focus not only in language but also in their author's understanding of engineering concepts and requirements were taken as proof that the writers were likely using English as a second language. This interpretation was then offered as a possible explanation for the weaknesses the assessors detected in the reports and which in turn would be a detriment to complete professionalism.

Academic assessors, more than industry assessors, raised the question of plagiarism, and more often on ESL than NES students' reports. Indeed, some suspicions of plagiarism were explicitly linked to ESL students, even if the example was actually from an NES report, e.g., "Report does not seem comfortable with English. This report gives me déjà-vu--I felt I'd read it before!" or "Obviously some sections were not written by the author of this report." The suspicion of plagiarism may be partly due to a noticeable shift in style or language use. It may also be that these professional engineers were not as used to dealing with writers whose language proficiency was not comparable to their own. More accustomed to a higher level of articulateness, the assessors may have been sensitive to aspects of the texts they were reading which did not seem consistent with professional norms and therefore they suspected an ESL background was the cause.

Although the assessors expressed common expectations about the specific features of a well-written technical report, there were two areas of striking differences between them. One was in the number of specific discrepancies in their evaluations of particular reports. The application of their shared discursive understanding was not consistent and at times their judgments were diametrically opposed. Several examples of such anomalous judgments were considered in Chapter 5 which presents the results of the assessors' evaluations. The inconsistency in determining elements of appropriacy in the twenty subset reports presented for their assessment encourages caution when accepting even professional assessments of a particular piece of writing, and further requires that the context of those decisions be examined more closely.

The other area was the noticeable difference in the variety and nature of the assessors' written responses. The stance taken by the assessors, evident through their language variety, invites an interpretation in terms of register, tenor and mood (Couture, 1985; Fairclough, 1992; Gregory & Carroll, 1978; Halliday, 1974, 1978;

Swales, 1990). Manifestations of differences in tenor may stem from and reflect situational differences.

The academic engineers did not, for the most part, seem able to detach themselves from their roles, or tenor, as teachers as they read the student reports. The somewhat pedantic tone and authoritative attitude apparent in some of their comments suggested that they expected the student writer would not only read the commentary but would make an effort to correct the errors so highlighted. The interaction between reader, text and writer was thus familiar, a closeness created by the academic assessors' position within the university. One can even speculate that the academics were more used to upholding direct authority over students through the weight of their commentary. In the academic world, engineers mainly see undergraduate reports only once, when they are handed in to be marked. Engineering professors are usually evaluators of text; they are seldom involved in the co-creation of texts, reports or any other writing carried out by engineering students, with the possible exception of working with graduate students attempting to enter the discourse community (ESL students especially), as some studies have shown (Brown, 1991; Casanave & Hubbard, 1992).

The industry engineers, on the other hand, tended to adopt a more distanced stance and seldom addressed the report writer directly. The industry engineers could be interpreted as taking a managerial role in their assessment, highlighting the attributes and deficiencies of each report as if reporting on it to a third party rather than expecting the writer to respond dialogically. These engineers were also likely more at home with a longer chain of readership in a milieu where discourse is generally created among and between peers. In their evaluations of reports or drafts of reports, industry engineers are more often engaged in a cyclical process of commenting followed by numerous revisions before the report is acceptable. Comments are offered with the expectation that these will contribute to changes in the draft cycle (Allen &

Thompson, 1996). Engaging in this process results in different linguistic choices just because the purpose of evaluation is so different. The more neutral language in the comments by industry assessors in this study supports this view of disengaged professional reaction to text.

In sum, the findings showed that academic engineers in their pedagogical role can have a different interpersonal relationship with students than do industry engineers working on draft reports with colleagues, whether junior or senior ones. The issue of engagement versus distance, of changes in tenor in text response, further confirms the variability of expert reactions (Gunn-Adam, 1994) and underscores the importance of being aware of context in the evaluation of writing.

5.4.3 Assessors' Decisions about Whether the Subset Reports had been Written by NES or ESL Students

The covering instruction sheet for each report assessed by the engineers asked them to judge, on the basis of the evidence available in the report, whether the report writer was an NES or ESL speaker. The answers were intended to be analyzed as a summation of the assessors' views of each student report writer's degree of native-English proficiency. The variability in the answers was revealing at a number of levels. The assessors selected some reports, including reports written by NES students, as having been written by ESL students, citing for their reasons numerous syntactic errors, mis-use of vocabulary, and so on. Poorer reports tended to be classified as having been written by ESL writers, a decision which reflected an apparent assumption that a document written by an ESL writer was necessarily poorer. The only report that all the assessors agreed on as having been written by a native English speaker was the NES student's report that had earned a Distinction level from the Writing

Project markers. All other reports created some range of disagreement from the engineers as a group.

Neither academic nor industry assessors judged the NES or ESL report writers accurately for all twenty reports. Industry assessors correctly guessed NES students' reports more often than did academic assessors, but since they also mis-identified ESL students' reports more often, it simply confirms that this group of industry engineers blended their assessment of many of the reports into the same Pass level. Individual assessors were apparently tougher in their assessment than others, in that they regarded more of the reports to have been written by ESL rather than NES writers, even when they had not. Yet other assessors selected more ESL students' reports as having been written by NES writers. There was no consistency in their judgments. Indeed, only two reports gained unanimous votes from all eight assessors: the NES Distinction student's report (as being by an native English speaker, as noted above) and a Pass ESL student's report who all assessors agreed was clearly not a native English speaker. Even the ESL reports which had failed were not consistently identified as being by non-native speakers.

Predictably, a question which asked a reader to decide on whether a writer was a native English speaker would provoke reasons in almost all cases that were related to language, usually in reference to very specific syntactic or lexical features, and this was the major type of response provided. In addition, many assessors mentioned the evidence or lack of what they called "natural language", "natural style" or "native-like flow" (their terms) but unfortunately did not provide much of an explanation for the specific attributes of this so-called naturalness. Occasional references were made to poor content control or disorganized presentation of the data as evidence of an ESL report (even when the report had been written by an NES student) which suggests that they were judging the report as non-native-like for reasons other than linguistic accuracy. On the other hand, some NES reports that

assessors thought were inadequate were nevertheless still identified as having been written by NES students. For the NES students' reports which they had judged correctly to have been written by NES writers, the assessors also cited naturalness, clarity and flow as the bases for their decisions. Despite careful analysis of the comments offered, it was not possible to ascertain what the exact components of natural language and style really were for the assessors. However, it was apparent that the naturalness of a report was related not only to the language used, but also to certain organizational frames, and to ways of focusing on content and of addressing the reader that agreed with general or professional expectations.

That is not to say that language was not a strong factor. The assessors made a point of distinguishing linguistic features that they claimed were ESL-based from those errors that they asserted were simply the result of sloppiness or inattention on the part of an NES writer. In one case, an industry assessor' commented: "The student has poor control over prepositions and tenses. A paper that doesn't read well, or is full of grammar errors, is not given much respect, and the author is not treated as professionally".[6] Even if there were only minor impediments to communication in a report, it was made very clear that a professional would not accept it if it were syntactically sloppy. For this assessor, at least, language errors were considered unprofessional, regardless of the mother tongue of the writer.

Many of the specific language-based reasons assessors gave for selecting a report as the product of an ESL writer were often the very ones that most English language teachers have the greatest difficulty getting ESL students to monitor and correct. The linguistic features that were mentioned the most as signaling the native language of the writer were similar to ones highlighted in the Natural Order Hypothesis (Dulay, Burt & Krashen, 1982) referring to

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[6] These comments are quoted solely in relation to guessing the mother tongue of the report writer and not taken from elsewhere on the appraisal forms or reports.

the acquisition order of syntactic features of English. The features noted by the assessors in this study included, for example, third-person singular s, irregular verb tense, prepositions, plural markers, and articles, i.e., language features which experience and research have suggested are among the last to be mastered by ESL learners. Since all of the ESL students would have had to have passed (in most cases) some sort of English proficiency test[7] in order to start their engineering program, one could presume these students to be, at the very least, at an academically advanced level of ESL. Yet it was clear that certain grammatical errors were still apparent and tolerance for them was generally low, if measured by the number of negative reactions by the assessors. This suggests that ESL writers in the profession, independently of their level of technical expertise, may continue to be disadvantaged even at the later stages of their second language development. One key to having a written text accepted is to reduce irritation in the reader; the assessors showed their level of irritation through their numerous references to linguistic and other errors in the reports.

In brief, there was a firmly held conviction on the part of these assessors that they were able to judge the difference between NES and ESL writers primarily on the basis of their use of language. This assumption has been shown to be unwarranted. The fact that both groups of assessors were incorrect about a third of the time for both NES and ESL reports shows that both ESL and NES writers manifested language that was unacceptable or appeared non-native to these engineers. The assessors apparently felt confident that natural or native use of English was discernible. The variability in the assessors' judgments about whether the report had been written by an NES or ESL writer, however, did not support this apparent confidence. The assessors did distinguish between language-based errors and simple sloppiness or typing mistakes, although they

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[7] In some cases, proof of proficiency may be simply satisfied by having graduated after a certain number of years in an English-speaking secondary education system. In other cases, ESL applicants may have had to take an actual language proficiency assessment.

signaled that each was professionally unacceptable. However, the implication was that ESL writers were more likely to produce both types of errors, despite the fact that NES writers were far from perfect in this regard. Some assessors were more likely to believe that a report had been written by an ESL writer when they had previously given the report a lower score. Writers favoured by assessors were frequently judged to be NES students, while writers whom the assessors scored low on the appraisal forms were judged to be ESL writers, including those who were really NES students. This was true even when these same reports were scored relatively high in the Language category by the assessors, so language use was evidently not the only basis for deciding whether a writer was an NES or an ESL student.

The assessors who thought a report to be an ESL student's product were also less likely to hire the writer. This relationship between judging the report to be by an ESL writer and deciding to hire is suggestive but must be cautiously interpreted. It is especially intriguing since the hiring question appeared as the first one in the professionalism category and was therefore part of the appraisal form's 36-question criteria the assessors worked with. The question about judging students to be NES or ESL appeared on the accompanying cover sheet for each report.

Finally, in many cases the assessors' responses to this question about deciding NES or ESL writers were contradictory for the same reports. This suggests that the assessors did not hold the same views on what the characteristics of acceptability actually entailed. This variability in assessors' responses supports the view that the determination of the acceptability of a piece of technical writing and the approximation of the writer to professional status depends almost as much on the reader and the context as it does on the writer. And it should signal to researchers and teachers that apparently objective assessments about technical writing, even from professionals in the field, should sometimes be accepted

cautiously and not as definitive indications of the actual quality of the product or the producer.

5.4.4 Additional Input from the Assessors

The unsolicited comments offered by the assessors illustrate the extent to which these professionals take writing seriously. Their views also confirm the differences noted in the research, namely that academic and industry engineers respond to technical writing from a commonly held general sense of appropriacy. However, these professionals occasionally specify the application of that discourse in somewhat different terms and with sometimes contradictory perspectives, i.e., the emphasis on format and language by academics, for instance, or the focus by industry assessors on making a client-centred impression and showing creative problem-solving skills.

5.5 Limitations of the Research

The interdisciplinary focuses, the variety of data sources, the quantitative and qualitative analyses required, and the implications of the findings have all imposed their own constraints on the results. The following considers some of the limitations in the study.

5.5.1 Determining the Size of the Sample Subset versus the Number of Engineer Assessors

The pilot study had suggested that a minimum sample subset of at least twenty reports would be required in order to balance the performance levels, the students (NES and ESL), and the key demographic variables. Since each report averaged at least ten typed pages this would still generate a minimum of 200 pages for the engineer assessors to read. Ideally, either the sample size or the number of assessors ($n = 8$ in the pilot study; $n = 9$ in the thesis) should have been increased. Practically, this would have been almost

impossible to achieve. A larger sample subset would certainly have widened the application of the criteria and made the findings more generalisable to the initial population of 202 undergraduate engineering students. However, regardless of the number of engineers willing to participate in the study, each would have had his or her assessment load increased to an unreasonable level and this would likely have generated a greater attrition rate in the number of assessors. Even once committed to assessing the reports, the assessors in the current research followed their own time frame to complete the task. Rather than risk losing their input altogether, the decision was made to simply wait for the final assessors to finish and to delay the completion of analysis until all sets had been returned. In the end, two academic assessors of the original six who initially agreed to participate never did finish the assessment and the decision was made, reluctantly, to desist in reminding them of their initial willingness to contribute to the research.

A corollary to the information on assessors was that in both studies, the pilot study and the current research, they were all male. Although this is fairly representative of the dominance of males in the field of engineering as a whole, a female perspective in the evaluation of technical writing would have been insightful. The only female engineering professor to agree to participate in the pilot study had dropped out before receiving the reports because she discovered she was pregnant with twins. She was not subsequently available for the thesis evaluation task the following year.

Finally, no ESL engineering professionals volunteered to participate, although the letters of solicitation were not sent exclusively to native-English-speaking engineers, either in the university or in industry.

5.5.2 Extending the Database through the Questionnaire to Students

The questionnaire used in the pilot study had been changed for the thesis with slightly different questions for some of the

demographic variables, specifically related to educational experiences, work experience and knowledge of other languages. Although not all of these proved equally important, they might have benefited from follow-up questions asking for more specific details about the type of education and the language and length of their academic experience. Other details concerning the students' understanding of the kinds of writing they thought they were doing in their engineering programs could also have been linked more specifically to their educational development in these areas.

5.5.3 Stage of Participants' Approximation to Professionalism

The current research was fortunate in having available a large sample of similarly situated undergraduate engineering students, all of whom had completed the same technical writing requirement. Within this group it was also possible to be assured of getting both NES and ESL students. The original intention had been to add to the study both graduating engineers (through the provincial accrediting institution) and recently graduated engineers who were starting their professional writing experiences. Difficulties with accessing confidential registration details and corporate documents, of assessing the similarities in the experiences and the types of writing, and of establishing a large enough database from these participants curtailed this intention. A follow-up study with the same students doing their fourth-year projects or while in their co-op program might have been useful in determining the extent of their progress in learning to write acceptably in their field. However, this was not possible within the time constraints of the current research. Nor did students give permission for further contact to be made in the subsequent years of their programs.

5.5.4 Asking the Assessors to Judge Whether the Report Writer was an NES or ESL Student

The covering instruction sheet accompanying the set of reports and appraisal forms asked each assessor to judge, based on the

evidence from the report, whether the writer was an NES or ESL student. The intention in posing the question was to ascertain if there were underlying assumptions held by the engineers as to a report's adequacy or acceptability as a professional document, and then to see if these assumptions would be related to the engineer's sense of the mother tongue of the writer.

However, an argument can be made, post hoc, against having included this question. Quite legitimate concerns could be raised that putting a question asking the assessors to judge whether the report writer was an NES or ESL student on the front instruction sheet could somehow pre-dispose the readers while they were making their assessments based on the thirty-six criteria encountered subsequently on the appraisal forms. It could be argued that knowing a report writer might be an ESL student would allow the readers to mark differently than if they assumed all writers in the sample subset were NES students. There is no clear answer to this possible criticism at this stage, except to reiterate that the assessors all knew in advance that the writers would be of mixed language backgrounds and to state that, in any case, they were often wrong in their judgments. And the reasons they were wrong added interesting insights to the findings.

5.6 Recommendations for Future Research on this Topic

Some of the limitations discussed above also offer focuses for future research that may prove fruitful to the discussion. There are other areas which could also provide interesting directions for future research, a few of which are outlined following.

5.6.1 Further Insights Directly from the Participants

Although several assessors communicated with me in letters, by email or in person, an organized set of interviews might have supplemented the insights they offered through their scoring and comments about the students' engineering reports. Further questions

about their views of technical writing, their roles as professionals both inside the academy and in the corporate domain, would have enhanced the understanding of their responses to the reports and of the exigences of professional writing practices. This may prove to be a useful study within the research on genre applied to the social view of writing for specific purposes. One particular area which has not been fully explored is the position of the second language professional, especially in terms of the person's progress through academic and professional certification. An attempt had been made during the pilot study to obtain access to graduating engineers through their provincial certification process, but the request was ultimately turned down for reasons of legal confidentiality. Direct access to engineers in the workplace may prove to be more feasible.

A number of interviews had been conducted with students in co-op programs and with instructors who teach technical writing to engineering students, both within the same and in other universities. The information from the interviews, although interesting, proved to be limited in scope and not specific enough to the data sources available for the research. Therefore a future study in the specific areas of teaching and learning engineering writing might provide additional insights.

Finally, a consideration could be made of the effects of electronic media and on-line communication on the composing skills of novice and expert writers in the field. Although some small descriptive studies have been undertaken (Artemeva et al, 1999; Mehlenbacher et al, 2000), a detailed analysis of both the learning process and the collaborative nature of writing could be useful for educators and engineering students alike.

CHAPTER 6: CONCLUSIONS AND PEDAGOGICAL IMPLICATIONS

6.1 Summary of the Findings

The answers to the research questions introduced in Chapter 1 (p. 73) required both quantitative and qualitative tests and analyses. The results and discussion of the findings were detailed in the preceding chapters. What follows is a summary of the major conclusions for each question, a synthesis of how these findings are related, and a subsequent discussion of the pedagogical implications of the research.

One underlying but not explicit expectation had been that the results for the ESL students would be noticeably different from those for NES students. This was not entirely the case: In this study, the qualitative or descriptive assessment of patterns revealed more interesting findings than statistical tests were sometimes able to expose. The first analysis of scores showed little difference between these two main groups of students in terms of their mean scores on the Writing Project. It was only through further analysis of the distribution patterns for those scores that the ESL students' strategic control of organizational and surface-level features provided some explanations for the apparent similarity. Qualitative more than quantitative observations of demographic information in relation to writing scores added to the complex picture of how the ESL students' had arrived at this point in their academic career vis-à-vis their NES classmates; in many cases, their success was hard-won, suggesting underlying patterns of writing practices that may continue to impose constraints on their professional development. The academic and industry assessors' responses to a sample subset of Writing Project reports provided the necessary professional perspective on the acceptability of the writing produced by both NES and ESL engineering students. The differences in their scores and variability in their comments on the reports invited an

interpretation in terms of the assessors' own professional roles. Their responses to ESL students' reports, in particular, raised some important questions about the readiness of this group of students to enter the workforce as technical writers.

6.1.1 Analysis of the Writing Project Results

The first research question (see Research Questions in Chapter 1, section 1.8, p. 73) asked whether there would be noticeable differences between the scores of NES and ESL undergraduate engineering students (N = 202) in a test of their writing proficiency, as presented through a credit course requirement to write a technical report.

The results of an evaluation of the reports required written by NES students (n = 109) and ESL students (n = 93) for the Writing Project showed similar means overall. Their distribution according to performance levels (Distinction, Pass, Borderline, or Fail) was also generally similar. These results could be expected, given that all the students had been admitted successfully into their engineering programs and would be considered good students. Further analysis of the results on a category and question basis indicated that the ESL students achieved this parity with the NES students by scoring higher for criteria relating to organization and structural features. Even at the lower performance levels, ESL students showed means in the Organization and Format categories that were comparable to those attained by ESL students at the higher performance levels, while the means for NES students in these same individual categories declined concomitantly with performance levels. Report results for ESL and NES students were therefore similar in their total means, but for different strategic reasons: Many ESL students had compensated for a weakness in ideational substance by mastering rhetorical form.

6.1.2 Relationship of Performance Levels to Demographic Variables

The second research question (see Research Questions, Chapter 1, p. 73) asked whether the results of the reports in the Writing Project were related to the demographic backgrounds and educational experiences of the NES and the ESL students. The quantitative analyses of scores and their subsequent relationships to demographic data more often suggested trends and possibilities than they did definitive correlations or statistical significance.

Analysis of the data produced the impression that some ESL students attained a level of proficiency that was comparable to that of their NES counterparts but that they had come through different experiences and routes to reach it. The first significant difference in scores related to the criteria appeared in the distribution across performance levels: All ESL females scored into the Pass level, a pattern not shared by either ESL males or NES students; this finding is strongly linked to the more rigorous adherence to organizational and structural criteria by ESL students in this study. ESL students were also older, on average, than their NES classmates, partly as a result of having had a longer period of secondary education and partly because more of them had delayed doing the Writing Project requirement or were attempting the Writing Project a second or even third time. The Writing Project task was clearly a daunting one for some ESL students in the research.

Results on the Writing Project did not vary significantly among the largest language groups represented (Tamil, Cantonese, French, and Mandarin). Most foreign-born ESL students were from Asian or South Asian countries but were not distributed evenly through the performance levels as their numerical representation would have suggested, since very few students from these areas attained the highest scores. The majority of the ESL engineering students were permanent citizens or landed immigrants, which suggests that any findings about their acculturation to the technical writing practices of their field will be relevant to their future career positions in Canada. Their distribution across performance

levels was more closely related to their time in the country rather than to their citizenship status, specifically to the mode of years (3 years) spent so far in the country rather than the mean number of years (just over 6 years). More students at the lower performance levels reported fewer years in Canada. The NES and ESL students' reported knowledge of other languages was not a measurable factor in their results, nor was work experience, although the ESL Distinction students (who were generally older as well) did claim more working experience, proportionally, than did other ESL students.

The ESL students in this study had a much more varied and inconsistent secondary school experience. There was no statistically significant increase in scores with the increase in number of years spent in Canadian high school because the samples were too small because of the number of variables involved for any meaningful test to be applied. However, most of the ESL students in the Borderline and Fail levels (11 of 18 students) had less than four years in the Canadian high school system. A difference was also observed in the number of ESL students (16%) who had required more than five years (up to eight years, in some cases) to complete their secondary education. This was in contrast to the few NES students (less than 5%) who had taken between five and six years to complete high school. Five of these ESL students were Tamil speakers and eight spoke a Chinese language. Many of these same ESL students seemed to have difficulty with the Writing Project; i.e., they required more attempts, had delayed taking it, or scored poorly. Completing academic requirements was therefore a challenge for some ESL students in this study, which hints at difficulties with adaptation to Canadian academic culture as much as with language proficiency.

The representation of ESL and NES students across their engineering programs was generally different, although the difficulties the students had in meeting the writing criteria were often similar within programs. Among the ESL students, specific language groups seemed to favour particular engineering programs,

perhaps for cultural reasons and possibly because some programs were perceived to be less language-intensive or more popular (i.e. more likely to lead to jobs where mathematical skills predominated).

In terms of the kinds of writing they reported doing, NES and ESL students ranked the types in roughly similar clusters. However, in an analysis of selection by performance level, ESL students both over-selected inappropriate genres and under-selected others in comparison to the more even (and likely more accurate) selection profile by the NES students in the same levels. Students in the lower performance levels both under-selected appropriate kinds and generally did not differentiate the genres very clearly. No matter what their performance level, NES students identified consistently the kinds of writing they were doing. There was no such consistent pattern for the ESL students. The ESL students' inability to differentiate written genres means that they may not be able to identify what is required by a particular genre.

In sum, the study showed that the assessment of the writing proficiency of undergraduate engineering students did not differentiate between NES and ESL students when only overall means were considered. However, an analysis of the distribution patterns of their scores showed that better management of organizational features by ESL students helped them attain scoring parity with NES students. When their two routes to success were examined more closely, both quantitatively and qualitatively through the data provided by the questionnaires, it was evident that some ESL students had undergone different challenges and employed different strategies to reach the same levels. The implication of this difference in experience may be that in order to facilitate the efficient acquisition of appropriate technical writing proficiency in both NES and ESL students, teachers must become aware of the experiential bases for the apparent similarities in scores that these two groups of students may manifest. Both NES and ESL students require focused training in technical writing; ESL students may

simply require different support mechanisms to help them develop a stronger academic and cultural understanding of this skill.

As outlined above, the term proficiency here simply implies comparable scores based on the criteria listed for the Writing Project. True academic and professional proficiency in technical writing, however, may be measured somewhat differently, as the results from the assessors' responses suggest.

6.1.3 Assessors' Evaluations

The third research question asked: What are the characteristics of the written work of second language engineering students with respect to the norms of their intended profession? The assessment by professional engineers of a sample subset of twenty undergraduate engineering students' technical reports contributed some interesting answers. The sample subset consisted of 10 NES and 10 ESL students' reports which had been selected through purposive sampling methods so as to balance performance levels as well as a number of other variables such as mother tongue, gender, age, and engineering program, for example. The subset thus included reports from NES and ESL students who had received equally acceptable results in terms of the criteria applied by the Writing Project markers.

The assessors, however, did not interpret the subset reports in the same way. The scores for each type of assessor correlated to a similar degree with the scores of the Writing Project markers. However, differences emerged when tests of significance were conducted. The four academic assessors marked both NES and ESL reports much as the Writing Project markers had. The five industry assessors, on the other hand, differed significantly from both the academic and the Writing Project markers in their evaluation of NES and ESL reports.

The industry assessors were higher in their scoring decisions overall; they had not differentiated as finely between the reports in

terms of performance levels as had the Writing Project markers nor even as much as the academic assessors had. The assessors were significantly different in the means for all categories except for Format: both academic and industry assessors agreed on what a technical report should look like and marked NES and ESL reports similarly on this aspect only.

Three related but somewhat different conclusions were evident from a quantitative analysis of the first of the more holistic evaluations requested by the last six questions on professionalism on the assessors' appraisal forms: First, the hiring decisions of the assessors were not always consistent with their scoring patterns on the preceding thirty questions for the same reports. Second, the assessors were not willing to hire many students as junior engineers, but when they were, they clearly favoured NES over ESL students. Third, the assessors' decisions about hiring the student writer on the basis of the report were linked to the judgment they made about the linguistic identity of the writer: Report writers who were guessed, rightly or wrongly, to be ESL students were less likely to be hired. In further reference to the question on the covering instruction sheet that had asked assessors to judge whether the writer was an NES or ESL student, their answers showed that with one exception (the 100% accuracy rate for guessing the NES Distinction student), assessors were not very accurate in judging a student to be either an NES or ESL writer. In most cases, the assessors' comments indicated that their judgments were based on the language used in the report, even when their scoring for that category on the appraisal forms did not support the same level of assessment, i.e. reports which had received adequately high scores for Language were nevertheless judged to have been written by ESL students.

Further inconsistencies were apparent from a qualitative analysis of the way the assessors commented on the reports, both on the appraisal forms and on the reports themselves. The assessors were quite forthright in their assessments of the reports, whether

written by an NES or ESL student, and sometimes even expressed their opinions forcefully. This was evident in the number of intense directed and undirected questions, the use of expressive punctuation, and the explicitly critical comments they wrote on the appraisal forms and reports. The number and specificity of the responses suggested that the assessors were self-assured in their beliefs about what determines the acceptability of reports as technical documents in their field.

Some of the comments written by academic and industry assessors were similar, both in substance and in style. Both groups commented on content, on students' grasp of the problem and framing of the solutions, as well as on weaknesses in language and formatting of the reports. ESL reports were criticized more frequently for possible plagiarism and for errors in understanding and in language use.

The assessors presented strong, professionally-based views of what good technical writing should look like. Their assumptions about the acceptability of certain aspects of these pieces of technical writing were expressed in similar words and drew on shared understanding. Through their criticisms, for example, they indicated that competent professional writers focus their writing towards clearly identified goals, organize and format their documents to serve those purposes, and are not careless or sloppy in their presentation. The assessors thus referred to standards that most likely sprang from professional experiences and training common to engineering practice.

There was, however, also a distinct divergence in the predominant positions each assessor took in his responses. A strong differentiation was noted in register, particularly in how the tenor of the assessors' comments varied depending on whether they were addressing the student writer or some other perceived reader. To summarize these findings: Industry assessors seemed to step back from the papers and reflect on them, not their authors. Academic assessors, on the other hand, addressed students more often; their

use of a pattern of second person pronoun address was very indicative of the different relations between interactants. The decision to include different types of engineers (academic and industry assessors) for this research as well as different types of writers (NES and ESL students) was therefore justified. As Faigley (1990) has pointed out, a discussion of the differences between novice and expert writers, or between experts in specific discourse communities, needs to remember that "there can be no one definition of an expert writer" (p. 47).

The assessors were equally strong in their individual written views on which subset reports were adequate and for what reason, as evident not only in the different scoring decisions but in the comments, the hiring decisions and the judgments about whether the subset report writers were NES or ESL students. In many cases, however, these engineers simply did not agree about whether a particular report was an acceptable technical document. Even though they seemed to invoke a shared understanding of professional acceptability for technical reports, the assessors' decisions were individual rather than communal. The bases for their judgments about particular reports were evidently more context-specific to their own roles as engineers than directly related to a more general notion about engineering writing. The assessors seemed to draw on this broader concept but filtered it through their own professional experience when vocalizing their personal judgments.

It must be made clear here that the purpose for considering the assessments of different readers was not to ascertain definitively these engineering students' actual level of proficiency in technical writing. Rather, it was to explore how different judgments might come to bear on such assessments. The factors that may have influenced so-called proficiency were therefore not limited to the students' own personal and academic experiences, but also to the criteria by which the markers (first the WTS faculty and graduate students, and then the academic and industry engineers) determined this proficiency and to the contexts in which these standards were

developed. The acceptability of technical writing by second language engineering students depends not only on linguistic and academic acculturation, but also on the stance taken by critical readers.

6.2 Perspectives on Acculturation to Engineering Writing Practices Through Education

The acculturation of NES and ESL students to appropriate engineering writing practices is partially understood in light of the educational experiences that predominate for them and with regard to the exigences of the professional context they are hoping to enter.

One aspect of acculturation that was highlighted by the findings of the research was the influence of prior educational experience on the ESL students. The findings suggested that many ESL students achieved performance parity with NES students on the Writing Project perhaps because they had spent longer years in a secondary school system, had finally succeeded after repeated attempts and failures on the Writing Project, had previously avoided or delayed starting its writing requirement, and had used strategies in writing such that control of surface features had masked weaknesses in substance.

ESL students' scores may also have been affected by different experiences and understanding of the writing tasks they faced, as shown, for example, by the inconsistency in ESL students' responses to the question on kinds of writing in comparison to the answers given by NES students. The inability to differentiate genres may reduce a student's ability to satisfy the requirements of a particular genre, with the potential of subsequently reducing access to the discourse community that demands it. This weakness was evident in how ESL students' reports were considered less acceptable to the engineers even though the reports had gained points on certain criteria in the scoring decisions. As Cope & Kalantzis (1993) assert, "Learning new genres gives one the linguistic potential to join new realms of social activity and social power" (p. 7). For many ESL

students in this study, access to the field of engineering was not yet realizable, if technical writing proficiency were the only measure.

ESL students frequently operate on the edges of the various cultures (local, academic, or professional) they are trying to access as they progress through their education and training (Carrasquillo & Rodriguez, 1996; Cumming, 1996; Derwing et al, 1999; Spack, 1998; Toohey, 1998, 1999). Whether academic difficulties are the causes or the results, some ESL students in this study had trouble getting to the parity with NES students shown by their performance on the Writing Project.

The research focus highlighted in the Toohey (1998, 1999) and Kanno (1999) debate on the question of marginalization of minority language school children may be of some relevance here. Kanno was disturbed by the notion of LPP ("legitimate peripheral participation") outlined in Toohey's 1998 article. LPP implies newcomers start off at the margins and then work their way closer to the centre of activities and status. Novices learn skills, (including language) as they engage in the practices of the community and then become experts in turn, progressively becoming integrated with the dominant group. Kanno disagreed with this view of minority language children's progress and instead saw the process of acculturation as one related to community-of-practice which includes the complex issues of maintenance of personal and social identity and not just a factor of language acquisition. The key to acculturation is access and Kanno felt the issue of minority language students' lack of access to interaction and to equal status with native speakers was not addressed by Toohey's views.

This description of students on the perimeters of social and educational experiences may explain to some extent why some ESL students seem to have difficulty in achieving the same academic standing as NES students. Yet ESL students in this study were able to overcome certain limitations through strategic control of their writing. Although they had not fully internalized the focuses and requirements of an academic, quasi-professional writing task, even

ESL students whose overall performance levels were unsatisfactory were nonetheless able to compensate for their conceptual and linguistic weaknesses by adhering to the superficial criteria that were easier to control, i.e., those primarily related to organization and format or to explicitly signaled elements that were relatively easy to include in the report.

There were two different consequences for these strategies. The first was an acknowledgment by both the Writing Project markers and the engineer assessors that certain organizational features of the ESL reports were more acceptable than similar features on NES reports. Secondly, and in contrast to the acceptance accorded the features through their scoring, the assessors saw through these strategies. This was evident in their comments on the appraisal forms and reports where they insisted on a stronger level of content comprehension and more sophisticated management of the arguments. In the end, most ESL students' reports were not acceptable enough to the assessors to gain employment for their writers.

Geisler (1994) describes the different perspectives of students and professionals concerning appropriate writing practices as arising partly out of the so-called problem spaces of novices and experts which are "different in terms of content domains and rhetorical practices" (p. 82). Geisler maintains that a great divide between the these problem spaces is maintained artificially. Schooling provides all students with a naive understanding of the more formal components of expertise but withholds an understanding of a tacit rhetorical dimension (Geisler, 1994, pp. 83-90).

Cope and Kalantzis (1993) also focus on the effectiveness of a rhetorical education: "To a certain extent, all genre theorists would agree that genre literacy should open student's educational and social options by giving them access to discourse of educational significance and social power" (Cope & Kalantzis, 1993, p. 15). But they also argue that the very genres that are historically taught in

schools are instruments of rhetorical and social power, even those that purport to be neutral: "Report is a genre that appears to be factual and voiceless. Far from it, reports carry powerful human agendas. Their neutrality is not just a part of their descriptive function. This is also a convenient pretence" (Cope & Kalantzis, 1993, p. 15).

The assessors who participated in this study appeared to perceive themselves as professionals belonging to an identifiable culture of engineering, and could therefore promote the profession's common writing standards. Their strong comments about what constituted a properly written report reflected a sense of appropriacy that implied shared professional experience with the rhetorical power of that genre.

The assessors did not refer explicitly to their personal workplace situations or connect their evaluations of the reports to particular practices with which they were involved, but their roles were evident. Academic assessors generally maintained a common pedagogical role, while industry assessors assumed a corporate role as shown in their references to clients and managers in their decisions about the acceptability of reports; both these views were examples of workplace-based expectations. Yet each set of expectations was fed by a shared understanding of over-arching principles of good technical writing. Their collective attitudes towards engineering writing thus invoked a "virtual rhetorical community" (Miller, 1994) of writing and of specific genres instantiated and negotiated in its particulars by mutually acknowledged members and recognized rules of membership. The intensity and explicit nature of the assessors' responses to the students' writing confirmed that for these professionals it was a very strongly defined culture (per Schein, 1991; see his definition in Chapter 1, p. 67). The profession's values about writing were therefore seen as communal norms even though the individual assessors' views on how such writing was actually manifested were occasionally contradictory. This tension between the invocation of a

shared standard and its individual application was evident in the contrast between the similar concerns the assessors identified in the NES and ESL reports and the differences among the assessors in relation to scores and responses to particular reports.

When the academic and industry assessors applied the criteria for their evaluations from within professional engineering frames of reference (as termed by Paltridge, 1997), evidence of their disciplinary expectations emerged. They understood the conditions of the simulation (and their external, distant roles) yet reacted spontaneously and naturally as practising engineers in expressing what a technical document should look like. They wanted students to understand the content at a deep level, to analyze the alternatives with critical judgment, to solve problems with contextual constraints in mind, and to frame their reports appropriately in form, organization and language. The assessors approached the writing task much as they would an engineering problem; for example, in assessing appropriacy they made it clear it was important to identify and solve the right problem and then to structure the text to present and evaluate solutions with specific reference to criteria and examples. This engineering method approach to solving a problem through writing is not usually part of a student's repertoire of strategies for text production.

As a mechanism for measuring the writing proficiency of engineering students within the academic exigences of their program, the Writing Project offered a simulation in engineering writing. But as an assessment instrument it could not provide the necessary engagement that would have allowed students to develop a full sense of professional writing practices. Despite the potential for a real world audience for their report (i.e., Ontario Hydro), both NES and ESL students operated within the rules of academic, not professional, behaviour. The students' assumptions about writing were framed within the schemata of their academic experiences (Horning, 1993), as reflected in their reading and writing practices on this assignment. Their reports were therefore more accessible to

those similarly situated, namely the academic assessors. The similarities in the academic assessors' scores on the reports with the original scores students had obtained on the Writing Project confirms this shared understanding. The industry assessors, on the other hand, were more removed from this pedagogical involvement, evident in one comment: "The report reads like an assignment where the student is looking for the right answer, when no answer is right."

The analyses of the evaluations of engineering students' writing suggest that learning to write professionally requires many more adjustments than the simple development of technical expertise or the limited control of surface-level and linguistic features. It also requires an internalization of the rules of membership, rules that, according to a common response within the social view of writing, will remain somewhat external to novices until they can actually engage in practice (Derwing et al, 1999; Freedman, 1987; Winsor, 1996a). These engineering students who were attempting to produce an acceptable technical document were clearly not fully acculturated to the requirements of technical writing. NES and ESL students alike were at the superficial stage of imitation, of learning the rules of production without internalizing the rules of behaviour as writers, appropriate to the task required.

Socioculturally appropriate behaviour, although rooted in an inherent capability, only develops through interactions in society. Cultural schemata are based on experience, cognitive framework, attitudinal set, and degree of emotional openness (Horning, 1993; Woods, 1987). The strategies that people employ to deal with ruptures in their frames depend very much on their cultural expectations or norms, not the least of which are those which have been internalized as part of the educational or work place culture. The engineering students' reports manifested a surface level of imitative writing partly because they were not fully in the culture of professional engineering. Their frames of reference were based on personal and educational experiences and so their reports, despite

superficial acceptability in formal characteristics and even at some conceptual levels, suffered from a kind of disengagement from the task. For ESL students, the difficulty was compounded, not only by weaker language control but by having to operate within cultural schemata that may not have provided a full understanding of technical writing and the forces that shape it within the academic and professional fields they needed to work in. The assessors rewarded the ESL students' organizational strengths and strategic inclusion of essential elements through their scoring. However, their strong criticism about the students' poor grasp of content and mis-directed focuses suggest these same students lacked a fundamental understanding of the genre requirements the assessors expected to see. The inconsistency in the responses to ESL reports by both academic and industry assessors further confirm a deeper dissonance between writers and readers than language proficiency alone would have produced.

Socialization into a field and into a way of writing reduces ambiguity for the individual; it also creates more uniform behaviour (in this case manifested by a more acceptable report) and reduces misunderstandings. But steps towards socialization are necessarily incremental. Acculturation to a discourse is progressive and as such is at least partly learned as well as acquired (Gee, 1998). Newcomers attempting to enter another culture, or a new discipline, can use many strategies to appear acceptable despite a weak foundation. One such strategy, simple imitation of the external aspects of a professional culture, can cloud the lack of a deeper understanding of the true demands of the discipline. For example, the assessors often suspected plagiarism, evident from a jarring discontinuity in style or linguistic choice and mostly noted on ESL reports. The instances of near-copying by ESL students supports the notion that novices who do not fully appreciate the limits of writing in a new field may resort to practices that seem acceptable, whether from personal or from cultural premises about appropriacy in citation (Campbell, 1987; Pennycook 1998). The students who plagiarized were using resources as they found them because they

were more comfortable with imitating authoritative ideas and words which rang truer than their own. In many instances copying may be a preferred practice according to their own cultural norms. The students' cultural and academic experience thus allowed a level of use of others' material which is interpreted as plagiarism in a Canadian academic context. When an assessor says "The writer doesn't seem comfortable in English", and then suspects the student is copying, the level of discomfort is also his own; he is saying that the student's plagiarizing violates his sense of academic standards for citing information. It was, in fact, the academic assessors who noted these apparent violations most often (e.g., "I suspect this product is the result of a group effort"). In this they were likely applying their academic, rather than solely professional, standards. This is noteworthy because such concerns about plagiarism were rarely raised by the industry assessors; the latter's apparent tolerance may arise from their more immediate experiences in collaborative writing in industry, where teams of writers produce text and the lines of individual ownership of ideas are blurred (Allen & Thompson, 1996). The judgment on plagiarism thus appears to be linked more closely to academic than corporate standards.

In addition to plagiarism, some ESL students' inability to differentiate between formal and informal ways of presenting ideas, as well as an inconsistency in focusing ideas towards a reader, a necessary step in accessing a shared schema (Horning, 1993), further violated the assessors' sense of appropriate standards for engineering writing.

The difficulties that some ESL students had in framing their arguments may also have arisen out of different cultural understanding about discursive and rhetorical appropriacy, even when the linguistic elements in their reports were acceptable: "Discourse, rather than syntax or phonology...is particularly influenced by differences between cultures" (Fine, 1988, p. 2). As Kaplan (1966) has argued, rhetorical frames may not be universal, even for concepts as apparently fundamental as paragraphing or the

bringing forward of topic versus supporting ideas. Many of the assessors in this study were critical of ESL reports for what they called a lack of logical order for reader preparation. Linguistic proficiency alone did not create this sense of inappropriacy.

All engineering students, even native English speakers born and raised in Canada, must acculturate to the profession, as they would to any other. However, students whose first language and first culture are not those of the mainstream must do more than learn language and even more than learn engineering in order to work on an equal footing with NES students. They must also re-assess their own cultural assumptions about writing that could well be dissonant or miscommunicative in their future workplace (Kaplan, 1983a; Lee, 2000).

6.3 Training in Writing for Engineering Purposes

As engineering students acquire the technical expertise in their fields, they must also absorb the communication principles and standards of oral and written text. The term absorb implies they are not explicitly taught and this is generally the case. In some institutions students are expected to take English, composition or perhaps even technical communication courses to upgrade these skills, particularly in writing (Braine, 1989; Ford, 1974; Mathes & Stevenson, 1976; Michaelson, 1984). The students involved in the Writing Project had no such course requirement at the time of this research.

The assessors who read the subset of student reports, both in the pilot study and the main thesis study, made frequent references to the fact that the student writers had not yet learned how to address the purpose of the document, that they had mis-represented the data or mis-led the reader, one who could be a potential manager or client. Part of this difficulty may lie in the fact that discipline-specific education does not always provide students with the understanding that workplace writing may frequently be directed outward, i.e., tasks are interactional more than instructional.

Writing for the workplace may therefore require training for skills not generally taught in the education system, since it requires a "discursive as well as a technical process of cultural induction" (Cope & Kalantzis, 1993, p. 12)

Providing writers with consistent feedback on their written products is one component of academic and workplace acculturation, but so is explicit training of writers to help them understand that the expectations of the organization can incorporate both real and virtual audiences in a wide variety of media (Bergmann, 2000; Robey, Khoo & Powers, 2000). In Canada, especially, this more open kind of training relevant to imagined as well as actual contexts must also extend to developing flexibility in dealing with cross-cultural contact, both organizational and linguistic. (See Kent-Drury, 2000, for example, for one description of collaborative writing practices in a technical environment that requires cross-disciplinary collaboration and even virtual perspectives in the creation of text). The teaching of writing for a professional engineering context must thus be guided by broader principles rather than narrowly defined prescriptions specific to a workplace.

The assessment responses of the engineers in this research showed that students required both a linguistic capability and a sense of the professional expectations about content analysis and presentation of information. In the assessors' views, few students in this study satisfied both requirements.

Unless they learn to comply with the assumptions and expectations of engineering writing, novices risk staying at the edge of the engineering community, regardless of their technical contributions. This study has suggested that some ESL students who have been exposed to different experiences from those that shaped their mainstream compatriots may find acculturation to full professional acceptance of their writing capabilities more challenging and at the very least a lengthier process. Illuminating the field to them through explicit instruction and focused discipline-relevant practice may therefore be desirable, especially

where practice includes information about the discursive power of rhetorical choices (Geisler, 1994).

One of the goals of teachers, then, must be to study the rhetorical demands of the fields their students plan to enter. In reference to such pedagogical responsibilities, Bazerman (1994) for example, claims that

> [d]iscourse studies of disciplines allow us to design courses that enable students to enter into disciplines as fully empowered speakers rather than as conventional followers of accepted practice, running as hard as they can just to keep up appearances. Even more, discourse studies can provide an enlightened perspective through which students can perceive the professional and disciplinary fields with which they will have to deal as outsiders.... (Bazerman, 1994, p. 75)

Bazerman sees writing expertise not as a transferable module, or a "plug-in" skill (p. 131), but as a set of "separate, varied skills that are combinable and capable of being complexly coordinated for specific tasks", a performance that "varies over time and across social boundaries...and responds to unique situations with individual conventions and backgrounds" (pp. 131-136). This complexity and variability must be clarified and enacted for ESL students; learning how to write for academic and then for professional purposes requires a discursive flexibility not normally available in writing courses that focus primarily on syntactic and lexical aspects of the language.

Geisler (1994) claims that schools do not teach students the rhetorical or persuasive nature of knowledge and that this awareness is not fully developed until late in their academic career. Novices tend to see writing as presenting fixed data and therefore they do not acquire a full understanding of the persuasive nature of any kind of writing until they are actively engaged in producing it for functional, work-related, purposes. This suggests that part of the problem lies in the education provided, even as part of the

necessary training is dependent on the discursive power of the workplace. Herndl (1996) relates, for example that technical writing formerly taught as formulaic process, is now viewed as social *praxis*, "to consider technical and professional writing as the work which shapes our values and allows for political and ideological action" (Herndl, 1996, p. 24). However, Herndl also claims that a rigid textbook tradition continues to dominate, setting standardized guidelines about the content and structure of technical documents. He sees this rigidity in guidelines for writing as an "instrumental view and responsive to the perceived demands of potential employers for practical skills" (p. 25) but one which therefore obscures the true nature of the discourse community it purports to serve. Winsor (1996b) argues that providing students with a proper sense of the rhetorical functions of engineering would better prepare them for later professional writing than would rigid rules for writing. But students are often firmly indoctrinated into the practices their educational system imposes, as was evident in her study of engineering graduates who still resisted the notion of rhetorical flexibility: "Despite overwhelming evidence for the importance of experientially produced tacit knowledge, the students believed in the importance of rules" (Winsor, 1996b, p. 167).

Part of the problem may lie in the undirected reading activities and genres that predominate in academic tasks students are most familiar with. Geisler (1994) cites the nature of academic reading as one of the sources of the difficulty: "School reading is a remarkably poor way to learn knowledge that departs from everyday concepts or for transforming knowledge", with the result that "schools fail to provide just what students need to edge towards expertise" (Geisler, 1994, p. 82).

Gwiasda (1984) hypothesizes that whatever writing skills undergraduates may have when they enter engineering actually deteriorate as writing skills are de-emphasized in favour of technical preparation. His point is that the engineering programs themselves contribute to this deterioration by, for example, setting

up false assumptions in students about writer and reader relationships. In contrast, Dudley's (1975) study showed that professional training alone neither ensures effective communication skills nor does it lead to the atrophy of prior writing ability, while communication skills appropriate to engineering can be developed if incorporated as an integral part of the technical training.

A variety of training programs, in Canada and abroad, have been developed which include the teaching of technical writing, both actively and incidentally. These range from model-intensive work to project-based writing, from analysis to case study reports, from purely academic (classroom-based) focuses to internship or co-op programs[1], and from guided writing to independent gathering or production and write-up of data, both in university courses and industry seminar sessions.

The approaches followed in these training programs have varied widely, in organization as much as in success. Co-operative programs, whereby students work in the field for part of their academic year, offer one useful method for instilling appropriate writing experience since they usually require progress reports connected not only to the engineering projects involved but to the development of insights and writing skills in the student. The focus in these programs, however, is not on the writing as much as on the processes of engineering work. Therefore, despite their benefits, they may not offer sufficient writing preparation for students already leaving the academic programs. Within the university setting, several studies support Railton's (1986) view that "a joint collaborative approach between an engineering department and a

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[1] There are programs aimed at helping graduated second-language engineers (mostly recent immigrants) develop the communications skills necessary to succeed in their careers in Canada. These include The Skills for Change Mentorship program in Toronto, for example, and the Young Engineers of Canada program of the Ottawa-Carleton Learning Foundation. In addition, there are university co-op programs similar to the one at Memorial University in St. John's, Newfoundland, which require engineering students to produce a substantial number of written reports for each of their workplace placements.

communication specialist is likely to be the most successful"[2] and that "[f]urther attention also needs to be paid to the specific skills required by practising engineers in industry" (p. 7). Having writing teachers work in tandem with discipline instructors is another possibility (Kutz, 1998).

Writing competence in a specialized discourse community such as engineering results as much from interaction between expert and novice to the field as it does from any knowledge of language or writing strategies taught to either one in the course of their professional development: appropriate writing develops "as a social practice shaped by its context" (Winsor, 1990, p. 124). Acculturation to a writing genre, then, is inherently related to subject matter and implicit modeling, as students "interact with experts who interpret and reshape their language until it matches accepted forms" (Bazerman, 1988, p. 304). But not all students have the opportunity for direct mentoring. Re-creating and expanding this process of re-shaping within the context of a technical writing course for engineering students will have to begin with an explicit consideration of such interactions and the lessons they present about cultural as well as linguistic appropriacy. Being engineers may help them in the best possible way to learn to write like engineers as they become subject to the social and contextual exigences of the workplace and fully appreciate the roles they must fulfill (Dias et al, 1999; Winsor, 1996; Zamel, 1998b). But this does not obviate the need for helping ESL engineering students to the greatest extent possible to be prepared for this next stage of their transformation into professionals. To expect students to actually be working as engineers before engineering writing demands are explicated denies them a crucial preparatory phase in their writing development, one that appropriate content-based or task-based training in English for specific purposes could support.

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[2] Some universities (for example, Concordia University in Montreal and Carleton University in Ottawa) have initiated programs whereby writing specialists work in close collaboration with engineering faculty on developing mandatory technical writing courses for their undergraduate engineering students.

6.4 Pedagogical Implications for English for Specific Purposes

Both ESL and NES students are actually in a community-of-practice situation (Dias et al, 1999) specific to their academic engineering programs. But to attain professional standing these students must be admitted to another community of practice, one whose writing, as well as technical, requirements are much more demanding. Some researchers on professional acculturation who focus on writing argue that a full understanding and development of professionally appropriate writing skills is not realizable until students are actually practitioners, i.e., writing within the truly interactive roles and contexts of their engineering workplace (Freedman, 1987; Winsor, 1999), or that ESL training cannot be effectively discipline-specific (Zamel, 1998b). The findings of this thesis, however, would suggest that appropriately focused training in writing for specific purposes would give all students, and especially ESL students, a useful access point. Pedagogy aimed at easing the transition from academic to workplace writing can move students beyond the imitative stage and towards gaining the necessary flexibility and resourcefulness for managing the process of engineering writing. The syllabuses and curriculum would shift in focuses depending on whether the students were NES or ESL students, but the basic principles and strategies for specialized instruction in writing for engineering purposes would be generally similar.

It should be noted that the context of the research is very specific: these NES and ESL students are undergraduate engineering students within a Canadian university program. Although workplace mentoring and post-graduate training programs are excellent alternatives for the development of writing in novice engineers, the research has considered only the constraints and requirements of students pursuing their engineering degree and writing in a university setting. Therefore the recommendations and options for the appropriate acculturation to technical writing are limited to best serving this particular population.

It is necessary not simply to understand the contextualized exigences ESL students face in their careers, but also to scaffold their transition to becoming effective professional writers within the context in which they are operating. This position is not a contradiction of the social view of writing and the insights it offers about how engineering graduates learn to write once they are in the workplace. Rather it focuses on the preparatory stage, their academic transition to professionalism, which also offers rich opportunities to promote awareness of the discursive and empowering aspects of genre literacy. The academic and rhetorical preparation of students for their profession can also be situated in a real context, one that could be more efficiently and effectively supported. It requires a curriculum that

> ...situates the student as the person who will need to be, and become, linguistically productive in the face of relatively unstable future situations, and can be successful in that only out of a productive knowledge of relevant cultural and social factors of their most common convergences in social situations, and of their linguistic production and realisation in specific textual forms, in genres. (Kress, 1993, p. 31)

The findings of this research suggest that adequate language counseling and/or intensive language training be recommended for students who have not had sufficient opportunities for acculturation but who are in university degree programs in Canada. The findings concerning the nature of the Canadian high school experience for ESL students underline the fact that there must be non-linguistic elements of that experience, alongside the normal linguistic practices, which can help mainstream the ESL student into producing levels that mirror those attained by Canadian-born students. If so, then these are identifiable and thus teachable to those without the benefit of a similar cultural experience and who need to fast-track their academic progress. More specifically, an integrated Canadian high school experience offers substantial modeling for the kinds of

writing tasks and evaluation criteria that students need to succeed in a Canadian university program.

The academic strategies and expectations of a Canadian high school experience should be reviewed and highlighted for ESL university students. Entry-level university programs could explain the general educational assumptions concerning problem-solving strategies, student autonomy, group work on tasks, teacher expectations, and specific literacy skills such as notetaking, referencing, composing, editing, and polishing written work. Those students without the same degree of cultural and academic experience must achieve parity through other supportive strategies that help them achieve a comparable level of academic standing. But, as Derwing et al (1999) found, ESL students do not need courses that are watered down since this means they get less information than NES students do and so fall behind in the subject matter. And as the discussion between Toohey (1998, 1999) and Kanno (1999) has highlighted, ESL students must be brought in from the margins of academic interaction (Early, 1992) through language support provided within properly articulated and enacted standards (Cumming, 1996) to achieve and maintain parity with NES students . But more than language training, ESL students need an explicitly focused understanding of the rich complexity of academic and professional interactions with text, as enacted in the creation of genres.

By providing the necessary practice, the strategies and the knowledge of what to expect as technical writers in their field while they are still in their disciplinary education, students could gain both explicit knowledge and implicit understanding of the directions their writing practices need to take. Even a limited degree of engagement with writing tasks that are modeled on professional communication would initiate an awareness of the necessary changes in strategic management of their writing. A content-based syllabus, in which students work through tasks incorporating real communication gaps in the resolution to a

problem, offers a framework for many interactive writing practices that could begin to foster such an understanding. Granted, simulations and classroom group work are not substitutes for the exigences of workplace reality, but allowing students to continue to write only as students with no sense of audience diversity, task differentiation, consequences of actual communication, and so on, is even less satisfactory. This preparation might be effective to the degree it paralleled the actual writing demands professional engineers tackle in their daily work. As the context-based responses offered by the academic and industry assessors to the student reports in this study have shown, it is necessary to articulate to learners the differences between academic and professional expectations about writing. Effective preparation for technical writing must help students appreciate the rhetorical community represented by the assessors in this study and move them closer to the centre of professional engagement.

As discussed in Chapter 1, there are diverse theoretical approaches that attempt to explain, both generally and specifically, the nature of the writing task, the linguistic characteristics of the text, the situation, the internal processing strategies, the psychological, and the socio-cultural, even political, forces that may influence writing. In addition, variables related to the acquisition of a second language skill impose an additional layer of considerations about what it means to learn to write appropriately.

What are, then, the constraints on the understanding and production of writing by ESL students that are both similar, and additional to, NES students' experiences with the process of writing? The theoretical considerations outlined in Chapter 1, the many years of personal teaching experience, as well as the findings of this research suggest that in order to create acceptable professional writing in their careers, second language engineering students need to learn to manage a great number of cognitive, procedural, linguistic, and discursive operations. Some of these are summarized following.

In order to write acceptably, ESL students must:

1) produce syntactically and lexically accurate text;
2) understand the semantic networks of their linguistic choices and select appropriate linguistic options;
3) know how to highlight or focus the information in ways appropriate to task, audience and locally accepted knowledge schemata;
4) be aware of possible first language (L_1) cultural constraints;
5) become informed about and practise the target culture's rhetorical expectations (both of the culture generally and of the discipline specifically);
6) understand that the writing process is seldom linear and may involve extensive changes in decision-making strategies;
7) be aware of personal preferences in managing the writing process;
8) understand that one's understanding of content knowledge may be discovered in the process of writing as well as transcribed;
9) be aware of how academic and professional roles affect the nature of scripts, conventions and linguistic selection;
10) conform to academic/professional text formatting requirements;
11) come to terms with the social and political consequences of writing within a particular discourse community;
12) be aware of personal learning styles to progress most efficiently through the stages of the acquisition of a language skill;
13) be aware of personal attitudes and motivation regarding acculturation to a profession whose language is not one's own and whose value systems may contrast with personal experience;
14) understand that mistakes, plateaus and regression are normal aspects of learning; and

15) be aware of previous training in both language and the discipline in order to adjust possibly unproductive habits of learning.

In order to help ESL engineering students manage these complex elements in their writing development, well-focused language training will be required. Studies on curriculum and program design for second language learners have underscored the unique characteristics of special purpose language training (English for specific purposes, or ESP), with a view to accommodating the requirements of a particular group of students as well as the institution or field of endeavour which they would serve. Principles of syllabus design, focused pedagogy and efficient utilization of authentic subject-matter text have been assessed and an increased emphasis has been placed on improving not just the ESL learners' knowledge of the language used in their fields, but also on enhancing their strategies within more communicative frameworks. A key underlying principle is that ESL students must be helped to perform professionally in language. They must be guided in developing behaviours that are appropriate to professional writing practices and not simply taught the rules of language to be set within an inflexible structural framework. Various perspectives on these features of language training have been offered through both first and second language research on writing (Bazerman, 1994; Brumfit & Johnson, 1979; Hutchinson & Waters, 1980; Mackay, 1981; Mackay & Palmer, 1981; O'Brien, 1993; Swales, 1980; Widdowson, 1979, 1983).

Language training programs that convey a sense of the multiple contexts in which the writing will take place, i.e., communicative and thematic-based or content-based pedagogy, will do much to enhance the learning of appropriate technical writing by ESL students (Jenkin et al, 1993; O'Brien, 1991, 1993). However, based on the findings in this study an argument could be made that in addition to encouraging risk-taking in students' efforts to communicate effectively, teachers also need to help students

develop effective strategies for self-monitoring and careful editing, so that written text produced by ESL writers becomes more acceptable to non-academic or workplace audiences. But the balance must be maintained: The teaching of ESP should encourage the management of surface features in the text, but not at the cost of content, as the assessors' diverse and intense comments on both conceptual and linguistic aspects of writing have shown. Further, it is necessary to provide training that will make explicit to students the relationship between the structure of a text and the ideas it presents, i.e., its form, content, purpose and audience. We need especially to encourage students to discover the rhetorical diversity and power of interactional writing, such that both ideas and writing are dependent on the collaborative feedback of others.

Model case studies could provide naturalistic input for discussion and further the understanding of how writing shapes decisions as well as how steps in problem-solving require certain kinds of writing. Developing the sense of distinctive genres within the field would reduce the confusion often felt by novices as they attempt to apply old patterns of writing behaviour to new situations. All these activities should be based on analyses of real workplace scenarios; students need to have their writing tasks directed outside the classroom if their technical writing is to gain realism both in their understanding of writing and in their shaping of it. Group tasks involving field research and necessary communication between members (and possibly with community contacts) in the form of memos, presentations, letters, reports, and the like, would improve writing more effectively than language analyses or reading comprehension exercises. At the same time, it would initiate a feeling of community purpose by engaging in the writing process such that novices would be somewhat better prepared for subsequent workplace roles. Naturally, the imitative aspects of any classroom activities will not substitute for authentic workplace exigences (Dais et al, 1999; Freedman, 1994; Freedman & Medway, 1994a, 1994b). However, realistic, interactive, content-based classroom tasks could develop the first necessary

awareness training in learning how to think like a professional and provide opportunities for constructive feedback. The industry assessors' stress on client considerations illustrates the need for such awareness in all engineering students.

Students learn writing by writing (Keyser & De Loatch, 1984). Tasks which expose students to the different genres of their field but which allow a sense of these to develop from activity more than just instruction will initiate an understanding of professional writing in its fuller discursive roles. Rose (1998), speaking of what he calls the "myth of transience", of temporary, deficient academic stages, argues that we need to "define our work as transitional or as initiating, orienting, or socializing to...the academic discourse community" (p. 28) and that fruitful analysis of academic and professional literacy will shift teaching's "mechanistic focus on error toward a demanding curriculum that encourages the full play of language activity and that opens out onto the academic community rather than sequestering students from it" (Rose, 1998, p. 28-29). While the acquisition of relevant discourses may require "exposure to models in natural and meaningful, and functional settings" (Gee, 1998, p. 54) before they can be internalized, the necessary meta-knowledge to understand these discourses may best be obtained by learning, i.e., through explicit instruction (Gee, 1998, p. 54). Orientation strategies in writing courses have to become as important as identification and analysis in technical problem-solving. Students can learn to treat academic assignments as they would on-the-job projects, with all the basic vital and fluid considerations of audience, purpose, and format that real engineering work demands. As one industry assessor in the pilot study put it: "The message for some of these students is that they should give the assignment exactly the same care that they would have done if it had been a real situation."

Most useful, then, are goal-based tasks which take education farther than is traditional, and which include a collaborative, highly interactive element. It is not enough to assign a grade, at which

point students throw the paper away (Freedman, 1987). What is needed in an effective ESP classroom is a follow-up or re-written assignment that responds to feedback in interaction with the content. In teaching report writing, especially, an assignment could incorporate an interim goal that depends on that report to complete another activity, much as occurs in industry. All of this could be accomplished with scaffolded language and content tasks that are both supportive and open-ended in their development. Modeling, collaborative (group) research for the input to and drafting of text, jigsaw or information gap activities, and tasks with goals beyond the grade itself are all features of a highly interactive writing program that could allow ESL students to appreciate how writing shapes and is shaped by activity. By engaging in tasks that are real for the academic stage in which they are situated, ESL engineering students can also begin to develop the strategic competence that will prepare them for the nature of future professional contexts.

The assessors' concern for the inadequate level of reading comprehension, and in particular the weaknesses they sensed in ESL students' reports, suggests that learning to read efficiently must become a vital component of ESL students' professional education. One way to begin is to help students develop the strategic competence that goal-based reading of authentic texts in different genres can impart. For example, learning to read for a variety of specific purposes can be related to diverse writing goals. The efficient development of reading and writing skills has been shown to be closely linked to subject-matter involvement (Mohan, 1986; Widdowson, 1983). Asking students to engage in content-based or thematic reading and writing tasks that are not only related to their engineering interests but are also authentic examples of the genres they will encounter (reports, schematics, textbook explanations, professional journals, technical specifications, case studies, and so on) is a start, but these activities must have a broader goal within and outside the classroom. Reading proficiency must also include an understanding of the rhetorical power of these genres. Swales (1990), for example, has shown how genre analysis can steer

pedagogy. Miller (1984) also asserts that for the student, genres serve as keys to understanding how to participate in the actions of a community.

Written genres are best accessed through appropriate reading strategies. As writers, students must learn to be aware of a reader's level of prior knowledge, just as they must learn to access the redundancy of texts they themselves read (Horning, 1993). Effective reading strategies, specific to the genres they will encounter, will move their writing from being novice, or reader-based, to expert, or writer-based competence (Hairston, 1990). In addition, learning how to accurately summarize others' words will benefit the student's own subsequent writing: "The ability to summarize information while reading,...carries over to the ability to discern the gist or goal of one's own writing" (Beach & Bridwell, 1984, p. 5). Thus, from reading, students learn to make decisions in writing that take into account different organizational frames for logic, for explicitness, or for linguistic choice. More importantly, students learn that writing in engineering responds to and is shaped by situation and action. They must learn the register of their field. Understanding the genres of their field is one point of access.

It is recommended that an interactive, highly goal-oriented, ESP engineering course be considered an essential part of an engineering curriculum for ESL students in order to support the acculturation of these students into the engineering profession. The components of such a course have been outlined in broad terms; syllabus specifics will naturally depend on needs analyses appropriate to the groups in question.

The research has suggested that some ESL engineering students have had to employ diverse strategies to be on an equal footing with their NES classmates and that not all of these tactics proved successful when their writing was presented to professional engineers for assessment. This is not to say that all ESL engineering students do poorly--far from it. But those who do well in all aspects of the educational experience are found to be those who have

mastered more than language. They have, through whatever means, learned to adjust to cultural and professional expectations through the genres they need to write. In short, they have understood the professional requirements of the engineering discourse community.

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APPENDICES

APPENDIX A: SAMPLE REQUEST LETTER TO ENGINEERING PROFESSORS

(A similar letter was sent to industry engineers in the community.)

Professor _____
Department of _____ Engineering,

Dear Professor _____;

I am writing to enlist your aid with a research project, specifically a comparative study of technical writing of native English-speaking and English as a Second Language engineering students.

Background:

My name is Trudy O'Brien and I am with _____ University's School of Linguistics and Applied Language Studies. Since 1989 I have taught an English as a Second Language (ESL) course specifically designed for full-time undergraduate engineering students whose first language is not English. My focus in this one-credit course is two-fold: first, to acculturate non-native English-speaking engineering students to the academic level of literacy required by the university and engineering profession; and secondly, to teach the fundamentals of engineering writing. These aims are usually combined through thematic or project-based writing assignments. The initial set-up of this course was greatly aided by the generous time and information provided by Dean XXX and various engineering professors who continue to provide important information about programs and courses.

As Assistant Director of the School of Linguistics and Applied Language Studies (SLALS), I have also been involved in admissions, placement, and registration policies and procedures for non-English-speaking students at [this university]. You are no doubt aware that the Faculty of Engineering has admitted a significant proportion of such students, some of whom require further English language support, such as provided through my course, as they pursue their Engineering program.

Research Project:

The focus of my current applied linguistics research is the acculturation process of second language engineers, specifically in the area of technical communication. In particular, I am investigating the salient characteristics of any differences between first and second language engineering writing as assessed by professors in university and practising engineers in the work force. My focus is on both linguistic and non-linguistic features that might emerge. This information will be invaluable in understanding how and why engineering students write as they do, and will further aid in suggesting improvements to the teaching of technical writing. You're certainly in a position to know that clear writing is an essential attribute in the presentation of technical data, and also affects the promotability of engineers, whether they be students or fully practising professionals.

I have prefaced my letter with this somewhat lengthy introduction in order to clarify my purpose in writing to you: I have conducted my second survey of the approximately 200 Engineering students writing their compulsory Summer Engineering Report. From this population base, I have selected a number of representative samples of writing from both native and non-native English-speaking students. I am currently repeating my pilot study with the 1995 group of engineering students. Primarily I am gathering further demographic information about these students (both native and non-native speakers) from which I am first extracting statistical data to correlate the interdependence of language, report results and background variables; and secondly, selecting a limited number of report samples, initially for independent evaluation by engineer assessors (both in academic and industry positions), and then later for my own linguistic analysis.

My results so far indicate very clearly that there are underlying tendencies in technical writing by engineering students, in some cases regardless of mother tongue. There are also strong suggestions that there are both qualitative and quantitative differences in the ways in which industry engineers and academic engineers approach the assessment of writing. These distinctions, both subtle and in some cases perhaps unexpected, suggest that a closer collaboration between industry requirements for technical writing expertise and academic practices in the teaching of writing would benefit both parties. This can only be achieved if the expectations of professionals on both sides of the graduation line could be clarified, especially with regards to the profession's norms as applied to and by writers whose first language is not English.

In summary:

> I would like to submit a limited number (20) of these samples to assessors such as yourself for both a checklisted appraisal as well as a holistic comment-based evaluation. I estimate the time required for this involvement would range between 5 and 6 hours total. Any comments you may wish to make about this project in particular or engineering writing in general would, of course, also be appreciated. Basically I am asking you to mark 20 short reports in accordance with the appraisal forms supplied and to provide comments.

Please contact me at your convenience if you are interested in participating in this project. Thank you for your time in considering this request.

Yours sincerely,

Trudy O'Brien,

[details re. replying]

APPENDIX B: QUESTIONNAIRE FOR WRITING PROJECT STUDENTS

1995 PROJECT REFERENCE #:_____

Dear Engineering Student,

My name is Trudy O'Brien. I am with the Centre for Applied Language Studies, the department which houses the Writing Tutorial Services conducting the Engineering Summer Project. As part of a research project, I would appreciate very much if you could take a few minutes to complete this form. It is a preliminary information sheet about you as an engineering student and a writer which will be used for research purposes only. THIS IN NO WAY AFFECTS YOUR ENGINEERING GRADES NOW OR IN FUTURE, and personal details will, of course, be held in confidence.

PLEASE PRINT: (This information is confidential.)

Surname: _____First Name(s):_____

Student ID:_____ Phone: _____

Local address: _____

CODES:

A. 1.Male:_____ 2. Female:_____

B. Age: _____

Current status: (Check (X) one that applies to you:

C.Program in Engineering: 1. Aerospace____2. Civil_____3. Computer Systems____
4. Electrical_____ 5. Environmental_____ 6. Mechanical____

D.Year: 1st.___2nd___3rd___4th___ 5. MA__ 6. PhD__ 7. Other (Specify)_____

E.1.Full-time:___ 2.Part-time: __

F. Is this the first time you have done this writing project? 1. Yes___ 2. No__

G.Country of origin:_____

H.Time in Canada so far: 1. All my life:___ **OR** 2. Since: Year 19____ Month:_____

I.1.Canadian_____2.Landed Immigrant_____3.Visa_____ 4.Other_____

J.Mother tongue (the first language you learned at home): _____

K.Other languages (specify): _____

L.Country/Province of education just before starting engineering program:_____

M. How many years of your high school education did you get in:
1. Canada: _____ years and/or in:
2. Home Country (specify) _____ ; _____ years
3. Other country (specify)_____; _____ years

N. Do you have past work experience in engineering? 1.Yes _____ 2.No_____

O. If yes,where did you work? 1. Canada____ 2. Country specify)_____

P. What kinds of writing do you usually do in your Engineering courses/work? (Check (X) all that apply to you.)

1. Short reports___ (up to 10 pages)
2. Long reports: (more than 10 pages)___
3. Lab reports ___
4. Assignment short para. answers ___
5. 1-2 sentence answers ___
6. Short essays ___ (Under 10 pgs.)
7. Long essays (more than 10 pgs.) ___
8. Examination short answers ___
9. Examination long answers (more than 5 pgs.) ___
10. Memos ____
11. Business letters ___
12. Proposals ___

I appreciate your completing the above. Please complete the consent form below:

(PLEASE PRINT)

I, _____, give permission to Trudy O'Brien, of the Centre for Applied Language Studies, to use this data for statistical purposes and to analyze my Engineering Project for research purposes. I am assured that all information will be kept anonymous and personal details will be held confidential.

Signed:_____ Date: _____

PLEASE SIGN AND THEN HAND IN, MAIL OR FAX THIS SHEET (both sides) TO:

Mrs. Trudy O'Brien,
Centre for Applied Language Studies, (CALS)
[address details provided]

APPENDIX C: EVALUATION SHEET: SUMMER ENGINEERING REPORT WRITING PROJECT

Questions in four categories which served to guide the students' writing and were used as marking criteria for the Writing Project. Results were made available for the research analysis.

I. Content Category:

1. Do you state the criteria you will apply in selecting recommendation/s from the alternatives suggested in the sources?
2. Do you give appropriate amount (not too little, not too much) of background information to provide a context for the discussion?
3. Do you review potential alternatives? (You do not have to include every alternative, only those that have some merit based on your criteria.)
4. Do you discuss the alternatives with reference to your criteria?
5. Do you systematically explain why you have chosen the recommendation/s?
6. Do you recommend your own original solution/s?
7. Is the focus of your report on recommendations?
8. Do you avoid redundancy (unnecessary repetition of the same information) in your report?
9. Do you refer to sources in the text of your report?

II. Organization:

10. Is your report organized logically? Do you have:
11. a title page
12. a table of contents (with page references)
13. a statement of purpose
14. a summary of recommendations (in point form)
15. background information (it may be included in the report as a separate section or as a part of the review of the alternatives)
16. a review of the alternatives
17. an analysis of recommendations
18. a bibliography
19. Do you have table that helps you to organize the information about the alternatives? (The report must still include a brief discussion of the alternatives even if there is a table.)

III. Format:

20. Are your pages numbered?
21. Is your report divided into sections and sub-sections?
22. Are the sections and sub-sections of your report numbered?
23. Do your headings reflect the content of the sections?

IV. Language:

24. Do you avoid personal pronouns?
25. Do you use parallel structure appropriately?
26. Do you avoid spelling mistakes?
27. Do you avoid grammatical errors?
28. Are you brief?
29. Do you avoid narrative style?
30. Do you avoid language like this: .

"Zebra mussels, those exotic little creatures who are inhabiting our waterways in great numbers, are curious, costly, prolific and hearty."

or

"This is the best alternative and the only one that will destroy these dreadful pests and prevent them from disturbing our peaceful Canadian waters."

or

Zebra mussels were first known to be a problem in Europe in the 13th C., when a navigator known as Thomas the Captain first discovered a mollusk clinging to the rudder of his ship, the clarion (formerly the Queen Bee)."

Notes. 1. These criteria were created by the Writing Tutorial Service Officer in conjunction with the Coordinator from the Faculty of Engineering. Faculty and graduate marking tutors assigned either full, partial or zero marks to each question to guide students in the draft process. Only final copies were scored. The final copy of each report received a score out of 30 points which was then converted to a percentage relating to a performance level: Distinction (90-100%), Pass (64-89%), Borderline (60-63%) and Fail (0-59%). Results served as data sources for quantitative analysis of NES and ESL students in the research. No changes were made to the questions for the research.

APPENDIX D: SAMPLE SUBSET OF TWENTY REPORTS FROM THE WRITING PROJECT

NES and ESL Students: n = 10 sample subset reports each

Gender: NES Students - Males 8, Females 2
ESL Students - Males 8, Females 2

Age Range: NES: 18-20 yrs (average: 19)
ESL: 19-32 yrs (average: 23)
The average age of the sample subset is 21 years

Status: NES Students: 10 Canadian Citizens
ESL Students: 5 Canadians, 3 Landed Immigrants, 2 Visa Students

Program:

	NES Students:	ESL Students:
Aerospace	2	1
Civil	1	1
Computer	2	2
Electrical	2	4
Environmental	1	1 (despite low representation in total pop.)
Mechanical	2	1

Year of Study: NES Students: 9 (1st year), 1 (2nd)
ESL Students: 4 (1st), 4 (2nd), 2 (3rd)

Number of Attempts: NES Students: 9 (1st) 1 (2nd)
ESL Students: 8 (1st) 2 (2nd)

Previous Education: NES Students: 9 (Ont./Cda.) 1 (outside Cda.)
ESL Students: 8 (Ont./Cda.) 2 (outside Cda.)

Work Experience: NES Students: 2 (yes), 8 (no)
ESL Students: 2 (yes), 8 (no)

Length of Stay in Canada: NES Students: 9 native-born, 1 foreign-born (but in Canada since a baby)
ESL Students: 2 (0-2 yrs), 2 (2-4 yrs), 3 (4-6 yrs), 3 (6+ yrs)

Knowledge of Other Languages: NES Students: 5 (Eng. only) 4 (Fr.) 1 (3rd+Lang.)
ESL Students: 7 (ESL only) 2 (L3) 1 (L4)

NB: Round-off points were required to get the appropriate ratio for a sample base of 10 NES students and 10 ESL students.

Mother tongues were also considered in the selection of ESL students, specifically by including a similar proportion of the larger language groups as much as possible.

APPENDIX E: SAMPLE SUBSET OF TWENTY REPORTS: DEMOGRAPHIC DETAILS

Country of Origin		Mother Tongue	n
NES			9
Students:	Canada	English	
	Scotland	English	1
ESL			1
Students:	Aden/Yemen	Arabic	
	Botswana	Setswana	1
	China	Mandarin	1
	Croatia	Croatian	1
	El Salvador	Spanish	1
	Hong Kong	Cantonese	2
	Pakistan	Urdu	1
	Sri Lanka	Tamil	2
Total:			20

APPENDIX F: PERFORMANCE LEVELS AND MAIN DEMOGRAPHIC DATA FOR THE SAMPLE SUBSET (n = 20)

Students	Level	Sex	Age	Program	Mother Tongue
NES	Distinction	M	19	Aerospace	English
n = 10	Pass	M	19	Electrical	English
	Pass	F	19	Mechanical	English
	Pass	M	19	Electrical	English
	Pass	F	18	Computer Systems	English
	Pass	M	19	Aerospace	English
	Borderline	M	20	Civil	English
	Borderline	M	19	Environmental	English
	Fail	M	19	Computer Systems	English
	Fail	M	20	Mechanical	English
ESL	Distinction	M	21	Electrical	Cantonese
n = 10	Pass	F	20	Electrical	Spanish
	Pass	M	23	Civil	Cantonese
	Pass	M	20	Environmental	Setswana
	Pass	F	21	Computer Systems	Arabic
	Pass	M	22	Mechanical	Tamil
	Borderline	M	19	Computer Systems	Urdu
	Borderline	M	32	Aerospace	Croatian
	Fail	M	26	Electrical	Tamil
	Fail	M	20	Electrical	Mandarin

Total: 16 Males: 8 NES and 8 ESL Students

4 Females: 2 NES and 2 ESL Students

Mean age: NES Students = 19 years; ESL Students = 23 years

APPENDIX G SAMPLE COVERING MEMO SENT TO ASSESSORS WITH SET OF SAMPLE SUBSET REPORTS, APPRAISAL FORMS AND REPORTS (n = 20)

MEMORANDUM

School of Linguistics and Applied Language Studies
[details]

To: Professor_____ / Mr._____
From: Trudy O'Brien
[details]
Date:
RE: Assessment of Student Engineering Reports

Enclosed is the complete package of information and reports that you will need in order to assess the Summer Engineering reports. The sample subset of 20 reports is a representative mix of the 202 first and second-year students in the faculty who both wrote the report and responded to the survey; namely, male, female, English-mother-tongue and English-as-a-Second Language (ESL) writers, none of whom are identified as such to you, of course.

I have also included for your information the set of data that students had available for this project.

The purpose of this study is to ascertain those characteristics (both linguistic and extra-linguistic) that would be assessed by professionals as nearing professional engineering standards. Since writing forms such an important part of engineering work, it is important that students be taught the appropriate communication strategies that would enhance their progress towards professional writing. Thus, analysis of actual reports must be balanced by the response given them by professionals such as yourself. We cannot teach students how to write coherently and appropriately if we don't identify more precisely what they should be aiming to produce in the work place.

You are one of 6 university and 5 non-university engineer assessors. Any time of year is busy for professionals and I know that now is no exception. I therefore sincerely appreciate your time and willingness to help in this project.

Might I ask if you could possibly return the package and your assessment sheets some time within the next 3-4 weeks? I will pick them up from your office/secretary at your convenience. Please call me or leave a message at the above numbers if you have any questions. Thank you.

APPENDIX H: COVER PAGE FOR THE APPRAISAL FORM FOR EACH REPORT (n = 20)

(Provided to assessors for their evaluation of each report in the sample subset)

REPORT REF.#_____

ASSESSOR:_____

Affiliation:_____ Phone:_____

Thank you for participating in this research. I appreciate your time and effort in assessing the technical writing of these engineering students.

Please complete the marking sheet provided for each report, noting the reference number. Circle "0" for "No, or Totally unsatisfactory", "1" for "Yes, satisfactory", and "0.5" for "Yes, but not really satisfactory".

Additional comments on the sheets or on the reports themselves are also highly valued, so feel free to write on the reports as much as you like.

**Based on the report, would you guess this writer is a native speaker of English (NES) or an English as a Second Language (ESL) writer?

NES:_____ ESL:_____

Why?

Ref.#_____

Office Use Only:
Marking sheet coded:___
Assessment correlated:___
Comments coded:___
NES___ ESL___

Result:_____

APPENDIX I: COMPARISON OF SCORES ON EVALUATION SHEETS: ALL PERFORMANCE LEVELS (BY CATEGORIES)

Q	Distinction				Pass				Borderline				Fail				Tot.	% per Question		
	NES	Yes	ESL	Yes	NES	Yes	ESL	Yes	NES	Yes	ESL	Yes	NES	Yes	ESL	Yes	per Q	All	NES	ESL
#	7	%	7	%	73	%	68	%	13	%	4	%	16	%	14	%	All	(N=202)	(n=109)	(n=93)
	Content:				Content:				Content:				Content:					Cont.	Cont.	Cont.
1	7	100%	7	100%	62	85%	57	84%	6	46%	2	50%	7	44%	7	50%	155	77%	75%	78%
2	6	86%	6	86%	58	79%	50	74%	8	62%	2	50%	3	19%	6	43%	139	69%	69%	69%
3	7	100%	7	100%	71	97%	66	97%	13	100%	4	100%	13	81%	13	93%	194	96%	95%	97%
4	6	86%	7	100%	45	62%	42	62%	4	31%	2	50%	6	38%	3	21%	115	57%	56%	58%
5	7	100%	6	86%	42	58%	43	63%	4	31%	1	25%	7	44%	2	14%	112	55%	55%	56%
6	5	71%	2	29%	19	26%	12	18%	5	38%	0	0%	2	13%	1	7%	46	23%	28%	16%
7	7	100%	7	100%	38	52%	51	75%	8	62%	2	50%	4	25%	4	29%	121	60%	52%	69%
8	6	86%	6	86%	56	77%	56	82%	7	54%	2	50%	8	50%	7	50%	148	73%	71%	76%
9	7	100%	6	86%	42	58%	39	57%	5	38%	2	50%	5	31%	2	14%	108	53%	54%	53%
M	58	92%	54	86%	433	66%	416	68%	60	51%	17	47%	55	38%	45	36%	1138	63%	62%	64%
	Organization:				Organization:				Organization:				Organization:					Org.	Org.	Org.
10	7	100%	7	100%	52	71%	56	82%	5	38%	3	75%	5	31%	5	36%	140	69%	63%	76%
11	7	100%	7	100%	71	97%	68	100%	13	100%	4	100%	16	100%	13	93%	199	99%	98%	99%
12	7	100%	7	100%	67	92%	67	99%	13	100%	4	100%	13	81%	13	93%	191	95%	92%	98%
13	7	100%	7	100%	62	85%	55	81%	5	38%	2	50%	5	31%	4	29%	147	73%	72%	73%
14	7	100%	7	100%	50	68%	52	76%	6	46%	0	0%	2	13%	3	21%	127	63%	60%	67%
15	7	100%	7	100%	73	100%	67	99%	13	100%	4	100%	12	75%	14	100%	197	98%	96%	99%
16	7	100%	7	100%	72	99%	67	99%	12	92%	4	100%	14	88%	14	100%	197	98%	96%	99%
17	7	100%	7	100%	63	86%	59	87%	6	46%	4	100%	6	38%	6	43%	158	78%	75%	82%
18	7	100%	6	86%	67	92%	61	90%	10	77%	3	75%	14	88%	11	79%	179	89%	90%	87%
19	2	29%	6	86%	20	27%	22	32%	2	15%	2	50%	2	13%	0	0%	56	28%	24%	32%
M	65	93%	68	97%	597	82%	574	84%	85	65%	30	75%	89	56%	83	59%	1591	79%	77%	81%

	Distinction				Pass				Borderline				Fail							
	NES	Yes	ESL	Yes	NES	Yes	ESL	Yes	NES	Yes	ESL	Yes	NES	Yes	ESL	Yes	Tot. per Q	All N=202	NES n=109	ESL n=93
	7	%	7	%	73	%	68	%	13	%	4	%	16	%	14	%				
	Format:				Format:				Format:				Format:					Form.	Form.	Form.
20	7	100%	7	100%	72	99%	67	99%	12	92%	4	100%	12	75%	14	100%	195	97%	94%	99%
21	7	100%	7	100%	72	99%	66	97%	13	100%	4	100%	13	81%	12	86%	194	96%	96%	96%
22	6	86%	7	100%	59	81%	54	79%	7	54%	4	100%	7	44%	9	64%	153	76%	72%	80%
23	7	100%	7	100%	57	78%	58	85%	7	54%	3	75%	8	50%	4	29%	151	75%	72%	77%
M	27	96%	28	100%	260	89%	245	90%	39	75%	15	94%	40	63%	39	70%	693	86%	84%	88%
	Language:				Language:				Language:				Language:					Lang.	Lang.	Lang.
24	7	100%	7	100%	70	96%	59	87%	10	77%	4	100%	11	69%	11	79%	179	89%	90%	87%
25	7	100%	5	71%	38	52%	39	57%	2	15%	2	50%	4	25%	1	7%	98	49%	47%	51%
26	6	86%	6	86%	60	82%	46	68%	11	85%	1	25%	10	63%	5	36%	145	72%	80%	62%
27	6	86%	5	71%	41	56%	22	32%	10	77%	2	50%	6	38%	2	14%	94	47%	58%	33%
28	7	100%	5	71%	46	63%	48	71%	6	46%	1	25%	3	19%	4	29%	120	59%	57%	62%
29	6	86%	7	100%	57	78%	55	81%	8	62%	1	25%	4	25%	5	36%	143	71%	69%	73%
30	7	100%	7	100%	55	75%	65	96%	9	69%	2	50%	8	50%	9	64%	162	80%	72%	89%
M	46	94%	42	86%	367	72%	334	70%	56	62%	13	46%	46	41%	37	38%	941	67%	67%	65%
Tot All	196	93%	192	91%	1657	77%	1569	75%	240	62%	75	50%	230	48%	204	45%	21 of 30	71% for All	72% for NES	70% for ESL

APPENDIX J: MOTHER TONGUES AND PERFORMANCE LEVELS

(NES Students, n=109; ESL Students, n = 93).

	Totals		Performance Levels							
			D	*DI*	PA	*PA*	BO	*BO*	FA	*FA*
Mother Tongues	n	%	n	*%DI*	n	*%PA*	n	*%BO*	n	*%FA*
English	**109**	**100**	7	*6.4*	73	*67.0*	13	*11.9*	16	*14.7*
Other Languages:	**93**	**100**	7	*7.5*	68	*73.1*	4	*4.3*	14	*15.1*
Tamil	21	21.6	1	*14.3*	17	*25.0*			3	*21.4*
Cantonese	16	16.5	1	*14.3*	13	*19.1*			2	*14.3*
French	10	10.3	1	*14.3*	6	*8.8*	1	*25.0*	2	*14.3*
Mandarin	7	7.2			4	*5.9*			3	*21.4*
Somali	5	5.2	1	*14.3*	4	*5.9*				
Arabic	4	4.1	1	*14.3*	1	*1.5*			2	*14.3*
Persian	4	4.1	1	*14.3*	3	*4.4*				
Urdu	4	4.1			2	*2.9*	2	*50.0*		
Spanish	2	2.1			2	*2.9*				
Bahasa Malaysian	1	1.0			1	*1.5*				
Cambodian	1	1.0			1	*1.5*				
Croatian	1	1.0					1	*25.0*		
Czech	1	1.0			1	*1.5*				
Gujarati	1	1.0			1	*1.5*				
Hungarian	1	1.0			1	*1.5*				
Indonesian	1	1.0			1	*1.5*				
Italian	1	1.0			1					
Khmer	1	1.0							1	*7.1*
Kurdish	1	1.0							1	*7.1*
Lebanese	1	1.0			1	*1.5*				
Polish	1	1.0			1	*1.5*				
Portuguese	1	1.0			1	*1.5*				
Setswana	1	1.0			1	*1.5*				
Slovak	1	1.0			1	*1.5*				
Slovenian	1	1.0			1	*1.5*				
Swahili	1	1.0			1	*1.5*				
Tegrigna	1	1.0			1	*1.5*				
Turkish	1	1.0	1	*14.3*						
Vietnamese	1	1.0			1	*1.5*				
Total:	93	95.8	7	*7.5*	68	*73.1*	4	*4.3*	14	*15.1*

APPENDIX K: COUNTRIES OF ORIGIN BY REGIONAL GROUPINGS

Regions / Countries	Sub-tot	Reg. tot	% of tot N = 202
North America		110	54.5%
Canada	109		
United States	1		
Asia		29	14.4%
Hong Kong	12		
China	8		
Vietnam	3		
Cambodia	2		
Malaysia	2		
Indonesia	1		
Macau	1		
South Asia		25	12.4%
Sri Lanka	21		
India	2		
Pakistan	2		
Africa		14	6.9%
Somalia	6		
South Africa	3		
Botswana	2		
Eritrea	1		
Libya	1		
Nigeria	1		
Middle East		11	5.4%
Iran	5		
Lebanon	2		
Aden/Yemen	1		
Iraq	1		
Kuwait	1		
Turkey	1		
Europe		11	5.4%
United Kingdom	3		
Czechoslovakia	3		
Croatia	2		
Holland	1		
Poland	1		
Romania	1		
Latin America		2	1.0%
Chile	1		
El Salvador	1		
	TOTAL:	202	100.0%

APPENDIX L: PERFORMANCE LEVELS RELATED TO TIME IN CANADA:
ESL STUDENTS ONLY (AS YEARS OF RESIDENCY OR AS AGE)

ESL Students by Performance Levels	Mean Scores (%)	Mean Years Time in Canada	Mode (Range)
Distinction (>90%)			
ESL, Foreign-born (n = 6)	90.5	3.9	3.3 (1.0 to 6.0)
ESL, Born in Canada (n = 1)	97.0	19.0	19.0 (19.0)
Pass (64-89%)			
ESL, Foreign-born (n = 60)	76.4	6.5	5.8 (1.2 to 21)
ESL, Born in Canada (n = 8)	80.9	19.9	19.0 (18 to 20)
Sub-totals: Upper Levels			
ESL, Foreign-born (n = 66)	76.0	6.3	5.5 (1 to 21)
ESL, Born in Canada (n =9)	82.7	19.8	18.0 (19 to 20)
Borderline (60-63%)			
ESL, Foreign-born (n = 3)	62.0	2.6	2.9 (1.0 to 3.8)
ESL, Born in Canada (n = 1)	63.0	20.0	20.0 (20.0)
Fail (0-59%)			
ESL Foreign-born (n = 12)	51.3	6.3	3.3 (1.5 to 15.3)
ESL Born in Canada (n = 2)	33.5	22.0	22 (19 to 25)
Sub-totals: Lower Levels			
ESL, Foreign-born (n = 15)	53.5	5.5	5.3 (1.0 to 15.3)
ESL, Born in Canada (n = 3)	43.3	21.3	20 (19 to 25)
Totals: ESL			
ESL, Foreign-born (n = 81)	73.2	5.9	6.2 (1 to 21)
ESL, Born in Canada (n = 12)	73.0	20.6	20 (18 to 25)

APPENDIX M: ASSESSORS' TOTALS ON SUBSET APPRAISAL FORMS BY CATEGORIES

Assessors's Totals on Appraisal Forms, by Categories: NES Students Only (n = 10)

		Academic Assessors, n= 4						Industry Assessors, n = 5						Total
Rpt. #	Proj. Level	Cont n=9	Org n=10	Form n=4	Lang n=7	% / Rept.	Acad. Level	Cont n=9	Org n=10	Form n=4	Lang n=7	% / Rept.	Indus Level	% / Rept
020	Pass	4.1	7.3	3.8	5.3	68	Pass	5.2	7.4	3.6	5.3	72	Pass	70
023	Pass	5.5	8.4	4.0	4.3	74	Pass	6.7	8.9	4.0	4.7	80	Pass	77
033	Pass	5.4	6.9	3.9	4.4	68	Pass	5.5	7.8	3.2	4.8	71	Pass	70
054	Bord	5.4	6.6	2.0	4.4	61	Bord	6.7	7.4	1.4	4.6	67	Pass	64
140	Pass	3.3	6.3	3.6	5.0	61	Bord	6.6	8.4	3.9	5.8	82	Pass	72
141	Fail	4.0	6.8	2.6	4.9	61	Bord	5.4	8.4	3.2	5.2	74	Pass	67
169	Fail	5.0	6.3	2.8	3.5	59	Fail	5.8	7.7	3.0	5.6	73	Pass	66
184	Pass	5.1	6.6	3.5	3.4	62	Bord	5.6	7.7	3.3	3.8	68	Pass	65
191	Dist	6.0	7.9	3.9	5.3	77	Pass	8.1	8.5	4.0	5.7	88	Pass	82
217	Bord	4.5	6.4	3.5	4.5	63	Bord	7.1	7.5	3.5	5.4	78	Pass	71
M	(cat.)	4.9	6.9	3.3	4.4			6.4	8.0	3.3	5.1			70
(%)	69	54	69	83	63	65	Pass	71	80	82	72	75	Pass	Pass

Assessors's Totals on Appraisal Forms, by Categories: ESL Students Only (n = 10)

		Academic Assessors						Industry Assessors, n = 5						Total
Rpt. #	Proj. Level	Cont n=9	Org n=10	Form n=4	Lang n=7	% / Rept.	Acad. Level	Cont n=9	Org n=10	Form n=4	Lang n=7	% / Rept.	Indus Level	% / Rept
061	Pass	5.8	7.1	4.0	3.8	69	Pass	6.7	8.2	4.0	4.5	78	Pass	73
090	Bord	5.4	8.4	4.0	4.6	75	Pass	5.8	9.6	4.0	4.0	78	Pass	76
106	Pass	3.4	5.4	3.8	3.5	53	Fail	4.9	7.3	3.5	4.7	68	Pass	61
119	Dist	6.3	9.3	3.9	4.8	80	Pass	7.9	9.6	4.0	5.9	91	Dist	86
137	Pass	7.1	8.4	3.8	4.8	80	Pass	7.1	8.7	3.9	5.1	83	Pass	81
170	Bord	5.9	6.5	3.8	2.1	61	Bord	6.5	7.4	3.8	3.1	69	Pass	65
180	Pass	4.6	6.4	3.6	3.5	61	Bord	6.4	8.0	3.4	4.4	74	Pass	67
185	Fail	3.6	5.6	3.6	4.4	58	Fail	5.3	6.8	3.8	5.2	70	Pass	64
198	Pass	4.5	7.3	3.0	4.0	63	Bord	6.2	9.2	2.9	3.7	73	Pass	68
226	Fail	6.1	7.7	2.9	4.0	67	Pass	6.9	7.4	3.0	4.5	73	Pass	71
M	(cat.)	5.3	7.2	3.6	3.9			6.3	8.2	3.6	4.5			71
(%)	69	58	72	91	66	67	Pass	70	82	90	64	76	Pass	Pass

Note. Cont = Content, Org = Organization, Form = Format, Lang = Language

APPENDIX N: ASSESSORS' ANSWERS TO THE PROFESSIONALISM QUESTIONS (#32 TO #36) FOR THE SAMPLE SUBSET OF 20 REPORTS

Professionalism Questions (Totals per 20 reports)

	Questions:					
	Q#32	Q#33	Q#34	Q#35	Q#36	Means
Assessors:	Overall	Cont	Org	Form	Lang	per Asr.
Academic #2	16.0	16.0	14.5	16.0	13.0	15.1
Academic #4	NA	16.0	12.5	13.5	12.5	13.6
Academic #5	11.0	12.0	13.5	15.0	13.0	12.9
Academic #6	3.0	4.5	6.5	6.0	5.5	5.1
Acad.Means	10.0	12.1	11.8	12.6	11.0	11.5
Industry #7	7.5	10.5	11.5	9.5	7.0	9.2
Industry #8	15.5	18.0	16.5	16.0	13.5	15.9
Industry #9	15.5	17.5	16.0	15.0	18.0	16.4
Industry #10	11.0	12.0	13.5	15.0	13.0	12.9
Industry #11	10.5	14.0	14.5	15.0	11.5	13.1
Indus.Means	12.0	14.4	14.4	14.1	12.6	13.5
All Means	11.0	13.3	13.1	13.4	11.8	12.5

Notes. Q.#31 (on hiring) was analyzed separately.

Assessor #4 did not answer question #32

The questions on professionalism are:

Assessor, on the basis of this report, would you:

Q#32 •say this writer has understood the requirements of professional writing?
•say this report is professional in terms of:

Q#33 Content?

Q#34 Organization?

Q#35 Format?

Q#36 Language?

APPENDIX O: ASSESSORS' ANSWERS TO QUESTION ABOUT WHETHER THE WRITERS IN THE SAMPLE SUBSET WERE NES OR ESL STUDENTS: BY REPORT

Guessing NES Students Only, n = 10

Report No.	Writing Project Level	Total Correct Guesses	Accuracy Rate for NES Students (%)
020	Pass	6	75
023	Pass	2	25
033	Pass	3	38
054*	Borderline	6	86
140	Pass	7	88
141	Fail	6	75
169	Fail	7	88
184	Pass	4	50
191	Distinction	8	100
217	Borderline	6	75
	Total Correct	55	70%

*54 = out of 7 assessors

Academic Assessors (n = 3) on guessing NES Students: 18/29 (62%)

Industry Assessors (n = 5) on guessing NES Students: 37/50 (74%)

Guessing ESL Students Only, n = 10

Report No.	Writing Project Level	Total Correct Guesses	Accuracy Rate for ESL Students (%)
061	Pass	4	50
090	Borderline	1	13
106	Pass	7	88
119	Distinction	2	25
137	Pass	2	25
170	Borderline	7	88
180	Pass	7	88
185*	Fail	4	57
198	Pass	8	100
226	Fail	7	88
	Total	50	62%

*185 = out of 7 assessors

Academic Assessors (n = 3) on guessing ESL students: 19/30 63%)

Industry Assessors (n = 5) on guessing ESL students: 30/49 (61%)

APPENDIX P: ASSESSORS' ANSWERS TO QUESTION ABOUT WHETHER THE WRITERS IN THE SAMPLE SUBSET WERE NES OR ESL STUDENTS: BY ASSESSOR

Assessor	NES Students n	Accuracy Rate (%)	ESL Students n	Accuracy Rate (%)	Total n	Total Accuracy Rate (%)	Missing n
Academic#2	8	(80)	4	(40)	12	(60)	
Academic#4							20
Academic#5	8	(80)	7	(70)	15	(75)	
Academic#6	2	(22)	8	(80)	10	(53)	1 (NES)
Industry#7	7	(70)	8	(80)	15	(75)	
Industry#8	8	(80)	2	(22)	10	(53)	1 (ESL)
Industry#9	7	(70)	7	(70)	14	(70)	
Industry#10	8	(80)	7	(70)	15	(75)	
Industry#11	7	(70)	6	(60)	13	(65)	
	Totals	(Means)			104	(66)	
Academic	18	(60)	19	(63)	37	(62)	
Industry	37	(74)	30	(60)	67	(67)	

Notes.

Full Subset n = 20 reports (NES Students, n = 10; ESL Students, n =10)

Two missing cases are pro-rated.

Assessors #2, 4, 5, 6 = Academic (#4 did not answer this question)

Assessors #7, 8, 9, 10, 11 = Industry

APPENDIX Q: NUMBER OF COMMENTS WRITTEN BY ASSESSORS (n = 9)

Table Q.1

Number of Comments Written by Assessors on Appraisal Forms

Assessor Type	Comment Box Category	Students NES Type of comments pos.	Students NES Type of comments neg.	Students ESL Type of comments pos.	Students ESL Type of comments neg.	Total No.
Academic (n=4)						
	Content	2	12	3	9	26
	Organization	0	5	0	4	9
	Format	0	3	0	0	3
	Language	2	1	0	2	5
	Professionalism	0	2	0	1	2
	Sub-totals	4	23	3	16	**46**
	% of sub-total	(9)	(50)	(6)	(35)	(100)
Industry (n=5)						
	Content	25	28	31	25	109
	Organization	22	23	23	20	88
	Format	11	12	14	16	53
	Language	11	21	10	33	75
	Professionalism	18	24	14	32	88
	Totals:	87	108	92	126	**413**
	% of sub-total	(21)	(26)	(22)	(31)	(100)
All Assessors (n = 9)	Total	91	131	95	142	**459**
	% of Total	(20)	(28)	(21)	(31)	(100)

Table Q.2.

Number of Comments Written by Assessors Directly on NES and ESL Reports, by Category

Student	Category Content	Organization	Format	Language	Totals	Assessor Academic	Industry
NES	173	17	35	298	523	322	201
ESL	177	9	102	567	855	507	348
Totals	350	26	137	865	1378	829	549
%	25%	2%	10%	63%	100%	60%	40%